PERCEPTIONS OF COMPETENCE AND ASSOCIATED STAFFING PATTERNS OF THREE LEVELS OF MEDICAL LABORATORY PERSONNEL

BY

JUDITH ANNE DAVIS

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By

Judith Anne Davis

The lyf so short,
the craft so long to lerne.
G. Chaucer

to

Herbert and Teeny
who allowed me to step to the music
I heard, however measured or far away,
and who supported and encouraged me
in all my steps.

and

to

Jim
who, in the hectic pace of my life,
reminds me of the still
point of the turning
world.

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PERCEPTIONS OF COMPETENCE AND ASSOCIATED STAFFING PATTERNS OF THREE LEVELS OF MEDICAL LABORATORY PERSONNEL

By

Judith Anne Davis

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Chairman: Margaret K. Morgan
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The purpose of this study was to identify commonalities and differences of perceptions of competence of three levels of certified medical laboratory personnel by medical laboratory educators, employers, and graduates and to determine relative changes in hospital staffing patterns as a result of the introduction of the medical laboratory technician level of certified laboratorian in 1970.

The study was concerned with testing 17 hypotheses relating to perceptions of competence and staffing pattern changes. The general questions posed by those hypotheses were the following:

1. Do educators, employers, and graduates agree in their perceptions of the degree of competence of the baccalaureate medical technologist?
2. Do educators, employers, and graduates agree in their perceptions of the degree of competence of the associate degree medical laboratory technician?
3. Do educators, employers, and graduates agree in their perceptions of the degree of competence of the certified laboratory assistant?

4. Does each category of personnel (educator, graduate, employer) perceive differences among the competence of medical technologists, medical laboratory technicians, and certified laboratory assistants?

5. Have changes occurred in staffing patterns of hospital laboratories as a result of the introduction into the job market of North Carolina hospitals of the associate degree medical laboratory technician?

The researcher distributed a task analysis questionnaire containing 270 tasks in six clinical areas of the medical laboratory to 154 medical laboratory workers including educators, employers, and associate degree MLT graduates. Responses obtained from 65% of those surveyed were analyzed with factorial and multivariate analyses of variance, discriminant function analysis, and bivariate correlation.

The major findings were categorized into demographic and statistical characteristics. The conclusions included the following:

1. Differences in the perception of competence of associate degree medical laboratory technicians were observed among educators, employers, and associate degree graduates.

2. Differences in the perception of competence of certified laboratory assistants were observed among educators, employers, and associate degree graduates.

3. Employers rated medical laboratory technicians lower on blood bank tasks than the other groups rated them.

4. Medical laboratory technicians were rated higher on serology tasks by their peers than by other groups.

5. Three levels of medical laboratory personnel were observed to have varying degrees of competence.

6. The emergence of the associate degree medical laboratory technician modified North Carolina hospital staffing patterns from 1970 to 1980.

Recommendations, including deleting the lowest level, the certified laboratory assistant, and identifying specific levels of competence for each educational level, were provided.

CHAPTER I
INTRODUCTION

Modern hospital clinical laboratories have been staffed with three levels of credentialed personnel for more than a decade. Prior to 1970, one or two levels of credentialed personnel, along with non-credentialed personnel, comprised the staff of most general hospital laboratories. Today, the staff of most modern hospital laboratories is comprised of a majority of credentialed personnel trained in one of three levels of formal, accredited laboratory education programs; non-credentialed personnel constitute less than 25% of the laboratory staff.

Since personnel in each level of certified laboratory workers may typically perform 90% of the routine procedures in the average hospital as they work alongside each of the other functional levels, many professionals in laboratory practice, education, and administration have asked if three levels of certified laboratorians are required, or even desired, for staffing clinical laboratories. If three levels of personnel are both necessary and cost effective, to what extent do differences in competence exist among the three levels?

Through the use of a task analysis questionnaire, this study examined the degree of competence of each of the three levels of laboratory personnel as perceived by educators, chief technologists, and MLT graduates in laboratory medicine. In addition, the study attempted to delineate the relative changes in staffing patterns during a ten year period for the purpose of ascertaining changes resulting from the introduction in 1970 of the "new breed" of laboratorian, the medical laboratory technician.

Background

Many changes in technological society occurred in the decade of the 1970s. Along with advances in industry, space exploration, transportation, communications, and sciences came great advances in health care. These changes in the health care delivery system resulted from technical advances and changes in philosophy concerning the delivery of health care services (Harris, S.E., 1975; National Commission, 1980). Costs of medical care spiraled while government and third-party payers (i.e., Blue Cross, Blue Shield) have demanded change (Harris, S.E., 1975). Along with greater expenses in training better practitioners has come the objective of cost effectiveness ("Medicine: Health," 1979).

Attention in the hospital clinical laboratory has focused on manpower and salaries (including the efficient use of personnel). The clinical laboratory educators have witnessed an expansion to three levels of training during the 50-year history of medical technology education. In the early 1930s, medical technologist education was initiated in several hospitals across the country (Ikeda, 1931). By the early 1960s, certified laboratory assistants were being trained in one-year, postsecondary programs, and in the late 1960s, education for the newest level, the associate degree medical laboratory technician, was begun (Montgomery, 1970).

Judgment as to the amount of education needed in all allied health fields has been changing. For example, the norm in education in medical technology has moved from a small, stable period of training of one level of personnel to a period of rapid growth in number and levels of programs. During this time, individuals and groups have been searching for identity. Some groups have felt threatened, especially in relation to the similarity and even overlapping of duties and status. Each group or level of laboratory worker, or laboratorian, seeks to establish its role, sphere of responsibilities, and area of contribution to laboratory medicine. As recently as 1980, the need to study education in allied health and to make recommendations concerning its growth, identity, and role in providing practitioners for health care delivery has been investigated. Recommendations have been published for the future of allied health education (National Commission, 1980). Individuals and groups have felt the need to review what has occurred in the allied health professions over the decade of the 1970s, to appraise those developments, and through research to form an alliance of allied health professionals (Hamburg, 1979).

While medical technologists (MTs) continued to serve as the backbone of the laboratory through the 1960s, certified laboratory assistants (CLAs) and medical laboratory technicians (MLTs) emerged on the scene of clinical laboratory science (Tomlinson, 1970). Medical technology educators have recognized the need for delineation of commonalities and differences in expected responsibilities and in curricula for the three levels of clinical laboratory education. CLA and MLT programs helped to augment the manpower supply of laboratorians in the late 1960s (Report, 1969). The mission of the 1980s was specified as the need to define specific competencies while identifying commonalities and differences in training for the three levels. Included in the mission was the need to provide career mobility as well (National Commission, 1980).

Educational programs have been established and are thriving for three levels of laboratorians. Now educators and practitioners must evaluate the effectiveness of these programs in light of job descriptions, task analyses, competence assurance, equivalency testing, career mobility, job satisfaction, and impact of programs on the cost effectiveness and quality of care provided by hospital laboratorians. Educators must decide which levels are needed and what direction curriculum development should take during and beyond the 1980s.

Statement of the Problem

Prior to 1960, education for laboratory workers was conducted mainly by hospital medical technologist (MT) programs. By 1962, all MTs were required to complete three years of college plus one year of hospital training in order to become certified (Montgomery, 1970).

An important change in the education of laboratorians occurred during the 1960s with the establishment of laboratory training programs at both the postsecondary and associate degree levels in technical and community colleges. The enactment of the Health Professions Educational Assistance Act of 1963 (PL 88-129) began a process that expanded opportunities for persons to enter a variety of educational programs in the health fields. The establishment of this Act partially stimulated technical institutes and community colleges to begin new programs to train laboratory workers at levels other than MT (Bureau, 1978). Shortly after the establishment of new training levels for personnel, graduates of CLA and MLT programs expressed a desire for career mobility and a need for academic equivalency (Perry, 1970).

The American Society for Medical Technology (ASMT) published a position paper in 1973 charting levels of laboratory skills at career entry for CLA, MLT, and MT graduates. This philosophical delineation of the three generalist categories did not, however, describe differences of performance of tasks among levels.

In order to assign simple tasks to laboratorians with less training and complicated tasks to those prepared for more responsibility, tasks must be identified as to their difficulty and the nature of the performance required. After sufficient task analyses have been developed, those who favor competence assurance have suggested that the data produced be used to derive task-oriented objectives and curricula for each level (ASMT, 1980). Attempts have been made to develop these task analyses (Bailey, 1973; Hedrick and Fiene, 1974), but for the most part they are obsolete. A reassessment is due since few associate degree MLT graduates were employed in the early 1970s. More than six years have passed since most of those data were collected, and many changes have occurred in medical laboratory education and in laboratory staffing patterns. In 1977, the president of ASMT indicated that the laboratory profession is quite different today than it was when ASMT began in the 1930s. The laboratory has changed, education has changed, and legislation has made the process complex. Fiorella (1977) suggested that in the 1980s the laboratorian must be an expert in the technical arena. This has been one reason to support the introduction of the MLT level.

Need for the Study

Since no attempts have been made to evaluate the various associate degree MLT programs, the task of evaluating one specific program in North Carolina was chosen for this study. Now that MLT graduates from the first seven classes at Sandhills Community College have been employed in hospitals and clinics and now that other programs have been initiated, an assessment of the Sandhills MLT program is appropriate. Five-year studies have occurred in other programs on different levels, but no such longitudinal study has been located for the MLT level (Rausch, 1977).

Purpose of the Study

The primary purpose of this study was to assess the overall impact of graduates from one associate degree medical laboratory technician program on staffing patterns in North Carolina hospitals. The broad goals were to identify

(1) Tasks performed by each of the three levels of laboratorians.

(2) Commonalities and differences in competence for the three levels of laboratorians certified by the American Society of Clinical Pathologists or the National Certifying Agency for Medical Laboratory Personnel.

(3) Characteristics of educators, employers, and MLT graduates, including demographic data, work setting, and specialty of employment.

(4) The impact of MLT graduates on laboratory staffing patterns of North Carolina hospitals.

The specific null hypotheses to be treated with statistical procedures were the following:

H01. No significant difference exists among the perceptions by educators, chief technologists, and MLT graduates, of the competence of MTs with one year of experience.

H02. No significant difference exists among the perceptions by educators, chief technologists, and MLT graduates, of the competence of MLTs with one year of experience.

H03. No significant difference exists among the perceptions by educators, chief technologists, and MLT graduates, of the competence of CLAs with one year of experience.

H04. Educators' perceptions of MT competence on blood bank tasks are significantly higher than those of chief technologists or MLT graduates.

H05. Chief technologists' perceptions of MLT competence on blood bank ratings are significantly lower than the perceptions by educators or graduates.

H06. Perceptions of CLA competence on blood bank ratings are not significantly different among chief technologists, educators, or graduates.

H07. No significant difference exists among the perceptions by educators, chief technologists, and MLT graduates, of the competence of MTs on serology tasks.

H08. MLT graduates' perceptions of MLT competence on serology tasks are significantly lower than the perceptions by chief technologists.

H09. No significant difference exists among the perceptions by educators, chief technologists, or MLT graduates, of the competence of CLAs on serology tasks.

H10. Category of rater (educator, chief technologist, MLT graduate) cannot be predicted from individual ratings of MT, MLT, or CLA by all raters.

H11. No significant discrimination effect exists among categories of rater on individual subject areas of MT, MLT, and CLA ratings.

H12. Category of rater cannot be predicted from the combined ratings of MT, MLT, and CLA by all raters.

H13. No significant difference exists in the perception by all raters of competence of MTs, MLTs, and CLAs with one year of experience.

H14. No significant difference exists in the perceptions by chief technologists of the competence of MTs, MLTs, and CLAs with one year of experience.

H15. No significant difference exists in the perceptions by educators of the competence of MTs, MLTs, and CLAs with one year of experience.

H16. No significant difference exists in the perceptions by MLT graduates of the competence of MTs, MLTs, and CLAs with one year of experience.

H17. The emergence of the MLT has had no significant effect on traditional staffing patterns in North Carolina hospital laboratories.

Limitations and Delimitations

The population for the study consisted of MLTs who had graduated from a training program in North Carolina between 1974 and 1979 and who were working in a North Carolina hospital or clinic during that time. The study also included the population of educators from all laboratory programs as well as chief technologists from all general, acute care

North Carolina hospitals. Data were collected only in North Carolina from the sample population of educators, chief technologists, and MLT graduates.

One concern was the use of ex post facto research. According to Kerlinger (1973), this type of research has certain weaknesses which include the inability to manipulate independent variables, the inability to randomize, and the risk of misinterpretation of data in terms of generalizations.

In this study, the independent variables did not lend themselves to manipulation since they represented the categories of respondents. These attribute variables were quantitatively treated as nominal variables. Kerlinger indicated that ex post facto research conducted with hypothesis testing has been important and valid in behavioral research (1973). Even though the structure of this study was a three-by-two (3 x 2) factorial design, certain limitations arose due to the unbalanced cells, the lack of randomization, and the fact that the independent variables were nominal in scale while the dependent variables were interval in scale.

Ideally all categories of respondents would be randomly selected. In this study, the only category of respondents that could be chosen by random sampling was the chief technologist group. Another limitation was the use of a mailed questionnaire which may have contributed to a low return rate. The small sample size may have been a limitation as well. Future studies of MLTs would be more appropriate for generalization if random sampling of MLTs occurred from several states or regions.

Assumptions

The first assumption was that the educators and chief technologists selected were true representatives of experienced medical technologists who could accurately complete the questionnaire. A second assumption was that the MLT graduates were representative of the associate degree laboratorian. The third assumption was that the measurement techniques used would demonstrate sufficient reliability for accurate statistical treatment and interpretation. A fourth assumption was that the tasks were valid representatives of those performed by laboratorians in most general hospitals. The last assumption was that ratings of competence reflected the normal distribution in the population.

Design and Organization

The ex post facto hypothesis-testing field study (Campbell and Stanley, 1963; Kerlinger, 1973) was conducted by distributing a task analysis questionnaire, developed by the researcher, to a sample population which included educators, chief technologists, and MLT graduates. Data were collected and keypunched for examination of 17 hypotheses by computer-generated statistical programs.

The study has been introduced in Chapter I. Chapter II is a review of the literature pertinent to the study. Chapter III presents greater detail concerning the development of the sample, questionnaire, and statistical procedures. Research pertinent to development of the instrument and statistics is also presented in Chapter III. Chapter IV includes demographic data and findings from the statistical treatment of specific hypotheses. The findings are summarized in Chapter V, which includes recommendations.

Definition of Terms

Career mobility. The ease with which a person may move vertically to the highest level of his capabilities within a specific career and laterally on to a related field (Amos, 1972).

Certification. A process by which one becomes credentialed in a specific health occupation in which those who possess basic job-related competencies succeed in passing a written examination.

Certified laboratory assistant (CLA). A graduate of a one-year postsecondary laboratory education program approved by the National Accrediting Agency for Clinical Laboratory Sciences. A CLA who succeeds in passing the certifying examination given by the American Society of Clinical Pathologists is designated as CLA(ASCP). Those who pass the certifying examination given by the National Certifying Agency for Medical Laboratory Personnel are designated as CLT, clinical laboratory technicians.

Competency. A relatively simple, observable behavior which can be clearly identified and precisely measured as to its frequency of performance (Johnson, 1977).

Competency assurance. The certainty that the practitioner is able throughout a career to carry out the responsibilities of the position filled (Wilson, 1977b)

Competent. The ability to carry out the total performance responsibilities of the given practitioner generic position (Wilson, 1976).

Equivalency evaluation. The comprehensive assessment of knowledge and skill competencies and the emotional attributes developed through alternative experience to the formal program (Wilson, 1977a).

Essentials. Written standards containing the minimal requirements that an educational program must meet for accreditation (Wilson, 1977a).

Generalist. A graduate of a laboratory training program which encompasses each of the broad clinical areas of laboratory medicine as opposed to any one specialty area. Also may refer to the training program itself.

Laboratorian. A general term used to describe any one of three levels of laboratory workers who have graduated from an approved educational program in laboratory medicine.

Medical laboratory technician (MLT). A graduate of a two-year, associate degree laboratory education program approved by the National Accrediting Agency for Clinical Laboratory Sciences. An MLT graduate who succeeds in passing the certifying examination given by the American Society of Clinical Pathologists is designated as MLT(ASCP). Graduates who pass the certifying examination given by the National Certifying Agency for Medical Laboratory Personnel are designated as CLT, clinical laboratory technicians.

Medical technologist (MT). A graduate of a baccalaureate medical technology program approved by the National Accrediting Agency for Clinical Laboratory Sciences. An MT graduate who succeeds in passing the certifying examination given by the American Society of Clinical Pathologists is designated as MT(ASCP). Those who pass the certifying examination given by the National Certifying Agency for Medical Laboratory Personnel are designated as CLS, clinical laboratory scientist.

Proficiency examination. An evaluation that tests for competence (derived from training and practice) in clinical skills, aptitude, and problem-solving ability (Wilson, 1977a).

Registry. A certifying examination for each level of laboratorian, administered to eligible graduates of approved programs by the American Society of Clinical Pathologists. Each examination consists of 200 multiple choice questions that are criterion referenced. The first MT examination was given in 1936, the first CLA examination, in 1960, and the first MLT examination, in 1970 (ASCP Board, 1980a).

Task. A logically related set of actions required for the completion of a job objective (Mager and Beach, 1967).

Task analysis. Identification and logical organization of the jobs to be performed through evaluation and redistribution of tasks up and down the career line (Amos, 1972).

CHAPTER II
REVIEW OF RELATED LITERATURE

Historical Perspective

Medical technology has been an allied health profession in the United States for 50 years. Since the establishment of the first medical technology programs in the early 1930s, many educational programs have been modified and others have been initiated to prepare technologists for the working situation and environment of modern laboratory medicine (Ikeda, 1931, 1935; Montgomery, 1970). As a result, three distinct levels of laboratory workers, or laboratorians, have evolved. The highest educational level is the baccalaureate medical technologist, designated MT(ASCP) by the American Society of Clinical Pathologists, and CLS, clinical laboratory scientist by the National Certifying Agency for Medical Laboratory Personnel. The middle level is the associate degree medical laboratory technician, designated MLT(ASCP) or CLT, clinical laboratory technician. The lowest level is the certified laboratory assistant, the CLA(ASCP) or CLT, clinical laboratory technician. Beginning with the August, 1980 Registry examinations, CLA and MLT graduates sit for the MLT(ASCP) examination (ASCP Board, 1980b). Both levels sit for the CLT examination of the National Certifying Agency for Medical Laboratory Personnel (NCA, 1978).

The growth and development of these three levels of programs may be understood by reflecting on the early days of medical technology. Medical technology, as a recognized profession, began in the same year that sound motion pictures were publicized ("Advent," 1929). The Board of Registry began in Dallas, Texas, in 1926 with the establishment of a Committee on the Registration of Laboratory Technicians whose function was to

> define a technician, possibly different classes of technicians, as Class A, Class B, and Class C, and then make it known that we have such a bureau which will bring forth applications for registration. We should be able to supply institutions with competent technicians upon request. (Montgomery, 1970, p. 435)

In 1929 a permanent Board of Registry was established to grant certificates to acceptable candidates and to approve schools for the training of laboratory technicians. The Board recommended adoption of the classifications laboratory technician and medical technician based on standards defined by the American Society of Clinical Pathologists. The Board of Registry instituted the use of the initials LT or MT after the registrant's name, and the Board added the initials ASCP after the first set of initials because several spurious organizations began using the initials LT and MT (Montgomery, 1970). According to a survey conducted by Ikeda (1931), 137 programs were training laboratory technicians in the early 1930s. Beginning in 1933, all applicants were required to have one year of preclinical college course work. Also, the first list of schools approved by the Board of Schools of the American Society of Clinical Pathologists and the American Medical Association was published in 1933 (Ikeda, 1935).

All laboratory technicians who held college degrees were automatically given the title medical technician by the American Society of Clinical Pathologists in 1935, and after 1936 the term laboratory technician was dropped. All registrants were then designated as medical technicians. In 1937, under the direction of Israel Davidsohn, the Registry published a model curriculum for schools ("News and Announcements," 1937; Montgomery, 1970). In an address to the Annual Meeting of the American Society of Medical Technology (ASMT) in Atlantic City, New Jersey, in June, 1937, the Registrar of the Registry of Medical Technologists of ASCP, informed medical technicians of what the Registry and certification had done for them in the short history of the Registry:

> since its inception the Registry has invested this useful calling with the dignity it deserves and created a proper spirit of appreciation for the members whose qualifications are vouched for by the Registry certificate, and whose work is primarily dedicated to the aid of human sufferers. In short, through this certificate of competence, the Registry has invested you with a profession.. . . [Today] due to the Registry, you have a specific title denoting an honorable and respected calling in the medical bodies of the country.. . . Like the M.D. or the R.N., the M.T. is now a recognized entity. (Scott, p. 148)

During World War II, an additional group of persons, named laboratory aides was established to fill a gap in laboratory practitioners (Montgomery, 1970). In 1958, the American Medical Association approved the revision of the model curriculum of Davidsohn and published the revisions in the Essentials of Accredited Programs. These essentials for schools of medical technology required that as of 1962, all students would be required to complete at least three years of college work before beginning the hospital year of medical technology. By 1967, the aides who had emerged during World War II were recognized as certified laboratory assistants, CLAs, and they functioned on the second educational level for which the ASCP provided certification (ASCP Board, 1970).

During the 1960s many health occupations programs were developed in the newly formed community colleges. Associate degree nursing programs began in community colleges in the early 1960s (Montag, 1972), and associate degree medical laboratory technician, MLT, programs began in the late 1960s (Montgomery 1970; Holley, 1975). The Board of Registry recognized this third level of clinical laboratory worker in 1970 and added a Registry examination for persons completing associate degree programs (Board of Registry, 1970). By 1970 administrative costs plus the large number of applicants for certification in CLA, MLT, and MT categories precluded the administration of practical examinations for certification (Montgomery, 1970).

One reason for the development of the associate degree MLT programs was the advent of Medicare/Medicaid legislation (Harris, S.E., 1975). To carry out the provisions of this legislation, manpower projections suggested the necessity for more efficient training for technicians (Report, 1969). To assist public community colleges in developing programs, federal funds were allocated for training allied health workers (Holley, 1975). Educators predicted the role of the community college in training allied health workers in the late 1960s (AAJC, 1968, 1971). The Allied Health Professions Personnel Training Act of 1966 and 1968 was designed to increase the opportunity for preparing allied health workers by increasing the quality of education and training in colleges and universities (Report, 1969).

The development of generalist programs in medical technology reached a peak by 1972. According to the American Medical Association's annual directory, 754 MT, one MLT, and 192 CLA programs had been approved by the AMA by July, 1972 (Allied Medical Education, 1973). These figures show that the majority of programs were MT level while approximately 20% were CLA level. Less than one percent were MLT level. In July, 1973, the AMA had approved 715 MT programs, 14 MLT programs, and 182 CLA programs (Allied Medical Education, 1974). By 1977, 667 MT, 64 MLT, and 116 CLA programs were approved by the American Medical Association (Allied Health Education, 1978). Fewer MT programs were initiated after 1970 while the number of MLT programs increased. Today almost 900 generalist programs enroll thousands of students each year (Allied Health Education, 1979).

When the Registry of Medical Technologists of ASCP offered its first certifying examination for the MLT level in 1970, brief guidelines for requirements to be included in associate degree programs were published. In 1972, ASCP established the MLT Review Committee with representatives from ASCP and ASMT and the Board of Schools. In 1974 the Board of Schools of ASCP was reorganized as an autonomous body with representatives from ASCP, ASMT, and other groups. The new body was named the National Accrediting Agency for Clinical Laboratory Sciences, NAACLS. The Review Committee which was formed began to set standards for associate degree programs (ASCP, 1972b).

Following the publication in January, 1972, of the Essentials of Accredited Programs for the Medical Laboratory Technician (ASCP, 1972a), one of the review committee members assisted in initiating the first North Carolina MLT program at Sandhills Community College. The first students were admitted in September, 1972. At that time, fewer than 15 schools for the MLT had been approved (Allied Medical, 1974). Subsequent to the founding of the Sandhills Community College MLT program, other MLT programs began to spring up across the state. Most had been

CLA programs that were being upgraded to the MLT level. The Sandhills program was, however, begun de novo. By 1978, three of the seven programs in North Carolina had been approved using the 1977 Essentials, and by 1980, site visits had been conducted at two other programs.

Differences Among Levels

With an increase in the number of MLT programs, a reassessment of traditional laboratory staffing patterns and a redefinition of competence at career entry was addressed by several educators. According to Perry, one of the dilemmas facing allied health in 1970 was the question

> by what means can we increase health manpower at a rate sufficient to provide qualified personnel for health care systems capable of delivering in both quality and quantity what has been promised as an inalienable right of society today? (p. 35)

Perry addressed the need for health practitioners, including medical laboratory workers, to examine the theoretical and pragmatic components of an educational program that would provide society with adequate numbers of well trained persons to fill manpower needs.

Tomlinson (1970) presented a lecture on clinical laboratory manpower and curriculum design to a manpower conference held at the University of Alabama in 1969. He proposed that a conceptual framework based on Bloom's taxonomy levels of educational objectives would provide a basis for investigating the levels of laboratory workers (Bloom, Englehart, Furst, Hill, and Krathwohl, 1965). Tomlinson (1970) also suggested that career mobility and identity were problems for the creation of additional levels of programs and that

> during the transition, individuals and groups are seeking their identity and relationship with others. Many feel threatened in relation to the closeness or similarity in duties and status, and in establishing identity. (p. 68)

In his hierarchical arrangement by taxonomy level, Tomlinson indicated that the primary difference in levels was the depth of preparation:

> content and experiences selected for programs should be selected to support performance standards. For a technician or a technical specialist to become a technologist, the additional background and competencies required could be identified, provided, and evaluated by the performance standards. (1970, p. 74)

Even in the early 1970s, the MLT and CLA graduates faced problems of career mobility. Reduced career opportunities have been related to too little or too much education and training according to Perry (1970). This loss of career mobility may have been related to poor definition of educational levels among CLA, MLT, and MT programs. Perry indicated that one solution to the problem would be to elaborate the specific knowledge and skills needed for each level of practitioner. This would lead to a defining of competencies among allied health specialists and among levels of individual specialties.

The American Society for Medical Technology published a position paper (1973) defining levels of laboratory skills needed at career entry for CLA, MLT, and MT graduates. The paper did not, however, indicate how one should judge the competencies required or the differences found among levels of laboratorians. The paper differentiated the three levels in each of the following areas: (1) performing analyses; (2) solving problems; (3) systems control, organization, and communication; (4) supervision and management; (5) teaching; and (6) continuing education. The educational expectations were briefly described for each level. According to the position taken by ASMT, differences existed among levels, but commonalities existed as well. The fine lines of distinction and commonality appeared to be clearly written on paper, but as other authors indicated, the differences were not so obvious in the pragmatic world of clinical laboratories in hospitals and clinics (Bailey, 1973; Hedrick and Fiene, 1974).

Educational programs have operated effectively at each level and some authors believed differences have occurred in training programs. These differences have been observed more readily in preclinical courses than in actual specialty courses. McDonald and Hedrick (1974) collected data from 94 MLT programs to identify curriculum offerings. At the time of their survey, fewer than 15 of the MLT programs had been approved by the Board of Schools (_Allied Medical Education_, 1974). At least 50% of the schools surveyed required behavioral sciences, and 78% required English, mathematics, chemistry, microbiology, and physiology. The ASCP published requirements for each of its three generalist examinations. The general education and specialty requirements were delineated along clear-cut lines. Each examination covered some unique areas and/or levels of knowledge for the role being tested ("Examination Content," 1975). Included in the guidelines themselves was a statement alluding to the ASMT position paper:

> the types of questions reflect the role of the various personnel categories _only_ at career entry--_not_ after several years of experience. (p. 1)

Pertinent Research

During the 1970s, professionals in medical technology became aware of the existence of each distinct personnel level both in educational programs and in the employment market. During this period of development of the profession, attempts were made to further delineate differences among levels (Bailey, 1973; Hedrick and Fiene, 1974; McDonald and Hedrick, 1974). These attempts to differentiate among levels were somewhat premature, especially for evaluation purposes, since a total of only 14 MLT programs were approved in 1973 (Allied Medical Education, 1974).

Bailey attempted to separate the MLT level from the CLA and MT levels by developing a task analysis of laboratory workers. At the time of her study few ASCP registered MLTs were employed in laboratory medicine. The intent of Bailey's study was to determine what educational background would be required to perform certain laboratory tasks. Bailey used a task analysis questionnaire which she administered to 190 laboratory workers in ten hospitals in Duval County, Florida. Results of the study included the findings that (1) there was no hierarchy of laboratory positions by function in the hospitals surveyed, (2) most tasks were performed by all levels of laboratorian, and (3) technicians perform more as generalists while technologists and assistants do more specialized work (Bailey, 1973).

Gleich and Routh (1974) developed a statistical study to test hypotheses concerning clinical laboratory manpower in Iowa. A response group of 47% of those surveyed was used in the testing. The Kendall-Tau test was used as a nonparametric statistical test. One of the hypotheses was that

> certified MT(ASCP)s will tend to perform more in a supervisory and administrative capacity than those certified as . . . CLA(ASCP). (p. 157)

To deal with this hypothesis, two contingency tables were developed. One dealt with certification and the other, with time spent in performing laboratory tests. The null hypothesis was not rejected because the amount of time spent in supervision along with the dichotomy of MT and MLT personnel showed a positive relationship between level of certification and time spent in supervision.

Hedrick and Fiene (1974) conducted a survey to determine which level of laboratory worker performed certain procedures. As part of the project, the authors developed and rated task descriptions. They calculated the frequency of performance of each task and prepared a difficulty-frequency plot which clustered the tasks into groups. Hedrick and Fiene indicated their results should lead to a job restructuring. They concluded that if complicated tasks were broken into simpler ones, less costly individuals (CLA and MLT) could share in the tasks, thereby utilizing all levels of personnel. In another project, Hedrick and Fiene (1975) attempted to answer several questions concerning the lack of job descriptions in medical laboratories. Their questions concerned the assigning of responsibility to certain levels of personnel, the providing of career mobility between levels, and deciding what persons in each level needed to be taught. One of the major concerns was "how can so much be learned in so little time?" (p. 50). The method used in the study was a "task characteristic" approach which identified the factors required in each task. This method allowed the researchers to rate the difficulty of tasks, determine the level of personnel which should perform each task, and decide what the person must learn in order to perform the task. The project, which has not been completed, included much task detailing (Hedrick and Fiene, 1975).

Reynolds, Love, and Krall (1976) attempted to determine the levels of laboratory workers who perform certain jobs in clinical laboratories in a specific geographical area. Questionnaires were mailed to laboratory directors of 111 West Virginia hospitals. Of those who responded from 55 hospitals, 53% were not certified, 26% were MT(ASCP), 4% were MLT(ASCP), and 17% were CLA(ASCP). By using the chi-square test of significance, the researchers discovered that MTs and CLAs performed the same routine tasks. Results were included for only seven MLTs, and the task inventories they completed were deleted from the final analysis. The researchers also deleted inventories from non-certified laboratorians. The researchers incorporated data from inventories completed by 64 MTs and 43 CLAs. The chi-square statistics which the researchers calculated showed that differences existed for the performance of chemistry, urinalysis, teaching, and supervisory tasks. Significant differences in the chi-square test were found for only 27 of the 165 tasks. Reynolds, Love, and Krall (1976) concluded that certification level was not necessarily a factor in assigning tasks to laboratory workers. The data may have been more conclusive if all three levels of laboratorians had contributed data to the statistical testing.

Dietrich (1976) conducted a study of MT and MLT student performance on a psychomotor test battery. The study involved testing a small sample of these students. The author used the Otis Quick-Scoring Mental Ability Test, the Minnesota Paper Board Form Test, the Bennett Mechanical Comprehension Test, and an experimental Manual Dexterity Battery. She calculated Pearson product-moment correlation coefficients. The Bennett scores correlated strongly with the Minnesota and Otis tests in the MT group but not in the MLT group. She concluded that tests measuring mechanical comprehension, spatial perception, motor skill, hand-eye coordination, and IQ showed no significant difference between MTs and MLTs. The MTs, however, scored slightly higher on the IQ test.

Cohen and Korper (1977) conducted a survey of MT, MLT, and CLA graduates of clinical programs in Connecticut. Graduates were questioned concerning methods they used in locating their first jobs and the relationship of their education to employment. The authors chose 436 graduates of 19 clinical education programs for the survey. The return rate was 66%. Since a greater number of the questionnaires were returned by MTs, the authors grouped together the responses of MLTs and CLAs. No significant differences in employment status were observed between the two groups. The small number of MLTs limited the analysis of data. The authors concluded that (1) a higher percentage of MLTs had obtained additional education, and (2) a higher proportion of MLTs had stayed at the clinical site where they trained.

Recent Trends

No recent studies comparing MLT and MT graduates as to manpower utilization, relationship to staffing patterns, or tasks performed, have been reported. The Center for Disease Control has, however, published several articles concerning methods of measuring workload productivity and performance (Bonin, Tronca, and Lawton, 1972; Elwell and Lawton, 1973; Lawton and Brownfield, 1975). These articles concern a relative value system for measuring workload and productivity. Lawton and Brownfield proposed an additional usage of estimating the number and level of personnel needed by the laboratory. These authors describe the implementation of the method but do not show how it has actually been used in a hospital to determine how many of each level of personnel are needed.

At least one report has indicated that the MLT and CLA may be grouped together in the future or that the CLA level will be deleted. The National Certifying Agency for Medical Laboratory Personnel administered its first examinations for medical laboratory personnel in July, 1978. Two, not three, generalist examinations were offered. One was given to baccalaureate medical technologists, and the other was given to both MLTs and CLAs. The step by NCA may prompt future attempts to eliminate the CLA level (NCA, 1979). Since the NCA examinations were introduced, ASCP will take a similar position by deleting the CLA Registry examination in 1981 (American Medical Association, 1980).

Several articles appeared in the literature in 1978 and 1979 concerning MLT programs. One of these concerned a career mobility situation for MLTs to progress to MT certification (Shoeff, Maturen, Fritsma, and Srugys, 1979). Another study dealt with the idea of competency per se. Morris (1979) presented a self-instructional approach to teaching MLT students. None of the studies dealt with the impact of MLTs on laboratory staffing patterns. Those articles which addressed staffing patterns referred to two levels, CLA and MT. Even in 1979 the MLT had not been fully understood, as pointed out by Miller (1979):

> the fact is that the MLT is fighting a battle to gain the respect of all members of the health care team, including his own co-workers in the laboratory. (p. 134)

Miller also indicated that the MLT can perform from 90% to 95% of the workload in the typical laboratory. Cost effectiveness studies have shown that MLTs are more cost effective and that it may be possible to maximize training of MLTs at minimal cost. Miller (1979) also indicated that MLT programs spend much of their time on non-routine procedures. Miller indicated that MLT programs could maximize their efforts by spending all their time on the routine tasks.

Several publications have addressed the future of allied health. A study published by the National Commission on Allied Health Education (1980) addressed several trends including (1) creating alliances for career mobility, (2) stimulating inter-disciplinary education, (3) creating justification of the level and the length of educational programs. In June, 1980, the ASMT unveiled its Body of Knowledge. This document is the first step in identifying competencies to provide a better understanding of the various levels of laboratory education and practice (ASMT, 1980).

MLT programs are still so young and much will be written concerning their usefulness in laboratory medicine as educators consider the future of allied health in general and the clinical laboratory sciences in particular. Some authors have treated the idea of competency, and perhaps when competency, per se, is better understood, variations and delineations among levels of laboratorians will be clear (May, 1979). Some authors have indicated that the technician level of personnel is here to stay (Kinsinger, 1979), and one allied health group, the respiratory therapists, has studied competencies in order to decide what levels should exist based on the competencies needed (American Association for Respiratory, 1980).

CHAPTER III
PROCEDURE

Selection of Respondents

Population

The researcher selected three potential populations from which to sample respondents to complete the task analysis questionnaire. The first population consisted of all chief laboratory technologists in the 145 general hospitals in North Carolina. North Carolina employers (chief technologists) had not employed registered medical laboratory technicians, MLT(ASCP), prior to 1974, which was the first year MLTs were graduates of North Carolina programs. The list of 145 hospitals chosen for the population was obtained from the North Carolina Hospital Association (1979).

The second population consisted of all educators in generalist laboratory programs in North Carolina. The list of educators was obtained from the North Carolina Society for Medical Technology and the North Carolina Department of Community Colleges (Eller, 1979). The total number in this population was 70, representing 25 programs.

The third population consisted of all MLT graduates of the MLT programs in North Carolina between 1974 and 1979.

Samples

The sample population of chief technologists was determined by stratified random sampling technique which included the use of a table of random numbers. Chief technologists were placed into strata by size of hospital before the random sample was made. The population then consisted of chief technologists of 61 hospitals having fewer than 100 beds (size A), 44 hospitals having from 100 to 200 beds (size B), 12 hospitals having from 200 to 300 beds (size C), and 28 hospitals having more than 300 beds (size D). In order to obtain equal representation resembling the population, the researcher selected percentages of each hospital type. Fifteen size A hospitals, 15 size B hospitals, four size C hospitals, and 12 size D hospitals were selected to comprise the sample of chief technologists. These individual chief technologists, who numbered 46, were then selected using a table of random numbers for each of the four strata or sizes of hospitals.

The sample of educators was chosen in a less random fashion. Two instructors were selected from each program in the state. A total of 22 schools was represented, and the list included educators from the 13 baccalaureate MT programs, the eight associate degree MLT programs, and the one CLA program. A total of 41 educators comprised the sample. Educators selected from programs with more than two instructors were selected by systematic sampling.

The third sample, MLT graduates, was selected from one MLT program by cluster sampling. Even though at least three MLT programs had been instituted in North Carolina by 1974, the researcher chose Sandhills Community College because it had more graduates, it was the only approved MLT program in the state, and the researcher had access to addresses of the graduates. Those MLT graduates from 1974 to 1979 for whom home addresses or location of work was known totalled 72. Those 72 comprised the sample of MLT graduates.

The final population consisted of 46 chief technologists, 41 educators, and 67 graduates. The task analysis questionnaire was distributed to each of the 159 persons in the sample population, but five questionnaires were returned to the sender. The final adjusted sample population totalled 154.

Data Collection

The researcher mailed a copy of the task analysis questionnaire and a stamped, self-addressed, return envelope to each of 46 chief technologists and 32 of the MLT graduates during the week of April 20, 1980. The cover letter and the instrument carried return dates of May 7, 1980. The cover letter contained an explanation of the purpose of the project. A form for biographical data was attached to each questionnaire. One form was developed for graduates, and another, for chief technologists and educators. The cover letter emphasized the fact that responses would be held in strict confidence and that all data would be evaluated and reported in statistical form only.

During the same week the researcher distributed questionnaires to each of the 41 educators who attended a meeting of the North Carolina Society for Medical Technology. The researcher instructed educators to return the completed questionnaires in the enclosed self-addressed, stamped, return envelope by May 7, 1980. The purpose of the project and specific instructions were explained to the educators, and opportunities were provided for them to ask questions concerning the forms. During the week of April 28, 1980, the researcher delivered questionnaires to the 40 MLT graduates who were working in hospitals within a 50-mile radius of Sandhills Community College. The purpose and importance of the project was discussed with each of the graduates who were also informed that the questionnaire would be collected the following week when the researcher planned to visit each of the 10 hospitals where graduates were employed.

Some questionnaires were returned by mail and others were collected by the researcher. Several articles have appeared in the literature advocating the use of a stamped, return envelope to increase response rates (Gullahorn, 1963; Sheth and Roscoe, 1975). Other researchers advocated personally delivering and collecting questionnaires to improve the response rate (Bailey, 1973).

Followup mailings by postcard were conducted approximately one month following distribution of the questionnaire. Cards were sent to each non-respondent who had received the questionnaire by mail. Telephone calls or visits were made to non-respondents to whom the researcher had delivered the questionnaires in person. Attempts to follow up those five persons for whom the questionnaires were returned by the postal service were futile. Several trips were made to the various hospitals to collect questionnaires. These trips proved successful for the most part. The personal touch of distributing and collecting questionnaires improved the return rate. Some authors have studied the effect of using followup letters and postcards. Significantly greater response occurred with followup (Hinrichs, 1975; Sheth and Roscoe, 1975).

The original cover letter is included in Appendix A. Appendix B contains the questionnaire. Biographical data forms appear in Appendix C. Appendix D contains the followup postcard, and Appendix E contains a second letter and postcard to chief technologists.

One hundred questionnaires were returned, representing 65% of the sample. Table 1 presents the response rate by category for each group

TABLE 1
RESPONSE RATE ON QUESTIONNAIRE BY CATEGORY OF RESPONDENT

Category	Respondents/Sample	Percentage
Chief Technologists		
Size A Hospitals	6/15	40
Size B Hospitals	6/15	40
Size C Hospitals	4/ 4	100
Size D Hospitals	8/12	75
Total	24/46	52
Educators		
MT Programs	16/27	59
MLT Programs	10/13	77
CLA Programs	1/ 1	100
Total	27/41	66
Graduates		
MLT	49/67	73
Grand Total Response	100/154	65

and where applicable, shows hospital size or level of program. The percentage of returned questionnaires ranged from 40% for two groups of chief technologists to 100% for size C hospitals and CLA programs. Efforts to increase both the number and percentage of respondents were unsuccessful. The potential sample totalled 159 persons. This figure represented the total number of persons to whom the questionnaire was delivered. Of the 159, 154 actually received the questionnaire.

To obtain data concerning numbers and levels of training of laboratorians in the state, the researcher mailed a letter and response postcard (found in Appendix E) containing information and instructions for providing the numbers and types of employees for the years 1970 and 1980 to all chief technologists who responded to the original questionnaire. The hospital-based MT educators who responded to the original questionnaire also received the second letter. The stamped, self-addressed postcards were returned with the information requested by June 30, 1980, from 75% of the persons to whom the letter was sent.

Instrumentation

The researcher reviewed the literature for several task analysis studies completed between 1970 and 1979. Several ideas were gleaned from a study undertaken at the University of California (UCLA) (Reeder, Freeland, Ott, and Sapp, 1974), the Bailey study (1973), and a study undertaken by the United States Office of Personnel Management (Goggin, 1979). Several studies from nursing and other health fields were also explored (Eller, 1978; McLane, 1978). One general observation concerning these studies was the fact that many contained more than 400 tasks. The UCLA study listed more than 450 tasks, and the Bailey study had 426. The study conducted by personnel from the North Carolina Department of Community Colleges for nursing contained only 206 tasks, and the dental hygiene study, conducted by the same organization, had 160 tasks (Eller, 1978).

Bailey (1973) asked respondents how often they performed certain tasks and where they learned to perform them. Other studies have asked respondents to determine the importance of each task for the profession being rated (Eller, 1978). The UCLA task analysis instrument asked respondents to tell (1) if they perform the task, (2) if they supervise the performance of the task by others, (3) how often they perform the task (as in the Bailey study), and (4) how difficult they believed the task to be (Reeder et al., 1974).

The questionnaire developed by the United States Office of Personnel Management was designed to collect data for new classification and qualification standards. Respondents were asked to rate each task for (1) the amount of time spent performing it, (2) the importance of the task for performance of the respondent's job, and (3) the level of difficulty of each task. A total of 450 tasks was included in the survey instrument (Goggin, 1979).

Previous studies have employed Likert-type scales with varying numbers of points. A study to predict successful nursing performance used different rating scale lengths varying from three to five items (Schwirian, Baer, Basta, and Larabee, 1979). The study from the North Carolina Department of Community Colleges (for nursing) used a five-point scale (Eller, 1978). Other studies of nursing have used as few as three rating points (McLane, 1978). Thorndike and Hagen (1977) advocated a rating scale of four or five points. Other studies, including one done by the Kettering group, used a five-point Likert-type scale to evaluate each factor or task tested (Hedrick and Fiene, 1975).

A nursing study conducted by the then Department of Health, Education, and Welfare used a 76-item questionnaire with levels of response ranging from three to five (Schwirian et al., 1979). A study of masters-prepared nurses employed a survey instrument containing 67 competencies. Each competency was rated by 35 respondents using a Likert-type scale with five points (McLane, 1978). Another nursing study was conducted by Smoyak (1970) using 38 items and a five-point scale.

Personnel in the community college system in Iowa conducted a study to determine common intra-cluster competencies needed in selected occupational clusters. An analysis of survey responses from a sample of MLTs on competency characteristics for their occupation was prepared. The MLTs were asked the percentage of the rate which they performed the item, the use frequency, and the training needed to achieve proficiency in the competency. MLTs were asked to rate only their level, and a three-point Likert-type scale was used (McClurg, 1978).

An inventory of competencies and skills for associate degree nurse graduates in Arizona contained three descriptors or levels of response for each item (_Inventory_, 1979).

A summary of the previous studies considered here shows that (1) an average of 250 tasks was used (range = 38 to 480); (2) most respondents were asked _if_ they performed the task; (3) Likert-type scales with values from one to seven have been used; (4) most surveys have asked only what the respondent does, not his or her perceptions of what others do; (5) some surveys have asked respondents to rate the importance of the task for their profession and the frequency with which they performed the task.

An analysis of basic designs from competency validation by Johnson (1977) showed a three-point Likert-type scale. Most of the Likert-type scales mentioned have been used to rate one "person" or level of personnel. Using this type of rating, no built-in bias exists since the rater was not asked to rate others using the same scale. When respondents are asked to rate three types of personnel, as in the present study, a built-in "halo" effect could occur with a three- or five-point Likert-type scale (Thorndike and Hagen, 1977). For this reason some studies have used a four-point scale. One such study was conducted using two methods, a summated four-point Likert-type scale and a nine-point scale score (Campbell, Dunnette, Avery, and Hellervick, 1973).

Having considered several relevant studies involving task analyses and the questionnaires used in those studies, the researcher constructed a task analysis questionnaire which contained 227 tasks and a Likert-type scale for rating. Tasks were developed by the researcher after reviewing other studies, course syllabi, procedure manuals of hospitals, and after discussing tasks with educators from each type of generalist program. Persons were asked to complete the questionnaire by evaluating the importance of each of the tasks for each of the three levels of laboratorians. The questionnaire, which contained specific instructions, was pilot tested on a group of ten educators from various levels of generalist laboratory training programs at a meeting of the North Carolina Society for Medical Technology held in September, 1979. At this meeting a group of the educators was chosen to provide expert consensus in each of six scientific areas represented on the questionnaire. These educators were asked to validate the content and appropriateness of the tasks.

The second revision contained 270 tasks. This revision, along with directions which asked respondents to evaluate the level of each task for their own level of training and to give their "feelings" about the level of competency for the other two levels of training, was distributed to the same group of educators. From the second pilot test, conducted in February, 1980, the researcher added and deleted several tasks and further clarified the directions.

In a third revision, instructions asked respondents to identify the degree of competence they possessed for each task and to indicate their belief about the degree of competence for the other two levels. Because of a "halo" effect observed in the first two pilot tests, the researcher chose to use a four-point Likert-type scale in the final version of the instrument. The revised task list contained 270 items. The breakdown by scientific area was as follows: urinalysis, 25 tasks; blood bank, 40 tasks; serology, 30 tasks; chemistry, 65 tasks; microbiology, 54 tasks; and hematology, 56 tasks.

Validity and Reliability

According to Johnson (1977), two approaches to validating competencies were useful. One method was the use of "expert consensus." A second method was "product assessment." For the present study, content validity of the questionnaire was accomplished using the ten educators who gave expert consensus. If the majority of these educators concurred as to the need for a particular task, the task was included. The valid tasks were those deemed important to effective job performance by laboratorians.

The second method of obtaining validity was the use of the product assessment mode. In this method, data were obtained from the systematic observation of the extent to which workers used the task. The researcher visited several hospitals where all levels of laboratorians were employed. Procedure manuals were consulted and the researcher observed technicians and technologists at work. The nine hospitals visited differed in size. The information gained from these observations together with that received from the panel of experts contributed to the content validity of the task list.

Reliability was partially determined with the "test-retest" method (Thorndike and Hagen, 1977). In the present study, pilot tests were given to MLT and MT educators six weeks apart. Correlation coefficients of the two scores were made. Another test of reliability was the use of the Spearman-Brown correlation coefficient, a statistic used to measure split-half reliability of the instrument (Hull and Nie, 1979).

Reliability and validity were obtained with test-retest, expert consensus, product assessment, and the reliability coefficients. The work of McLane (1978), Thorndike and Hagen (1977), Johnson (1977), and Nelson (1978) supported the use of these methods.

Method of Data Analysis

The researcher collected data which were coded for keypunching for computer analysis. The Triangle Universities Computation Center's IBM 370 computer was used. Appropriate subprograms were obtained from the *Statistical Package for the Social Sciences* (SPSS) (Nie, Hull, Jenkins, Steinbrenner, and Bent, 1975; Hull and Nie, 1979) and the *Statistical Analysis System* (SAS) (Barr, Goodnight, Sall, Blair, and Chilko, 1979). Data were entered as raw input from computer cards. The subprograms of the software packages used for this study included ANOVA, Discriminant Function, Frequencies, ONEWAY ANOVA, Pearson Correlation, Scattergram, and Reliability of the *Statistical Package for the Social Sciences*.

While the identity of each respondent was, of necessity, known to the researcher, data forms carried no personal identifiers of colleges, hospitals, or names of respondents. Individual responses were sorted according to the category of the rater. Table 2 presents the independent and dependent variables used in the study. The independent variables provided the categories into which the forms were sorted to measure the dependent variables.

The design of the study was a three-by-two (3 x 2) factorial, fixed effect, hypothesis testing field study as described by Kerlinger (1973). The first factor, category, termed "A" had three levels (educator, chief technologist, graduate). The second factor, level, termed "B" had two levels (MT, MLT). The scores on the ratings of MT, MLT, and CLA personnel were the three dependent variables. Other dependent variables were calculated. All dependent variables were continuous, interval in scale. The additional dependent variables were calculated with mathematical operations in the subprograms, as seen in Table 2, from the three primary dependent variables (overall ratings on MT, MLT, and CLA). The independent variables were categorical, coded as nominal. According to Kerlinger (1973), factorial design is the structure of research in which at least two independent variables are juxtaposed in order that one may study their interactive and independent effects on a dependent variable. In this study, three levels of two independent variables were juxtaposed and acted on several dependent variables. Because of more than one dependent variable, the study was a multivariate factorial design.

The study had been a potential 3 x 3 factorial design, but fewer than three respondents comprised the third level of "B" which was deleted.

TABLE 2
IDENTITY OF DEPENDENT AND INDEPENDENT VARIABLES

Dependent Variables	Independent Variables
Y1. Overall rating on MT	A. Category of Rater
Y2. Overall rating on MLT	1. Educator
Y3. Overall rating on CLA	2. Chief Technologist
	3. Graduate
Y4. Mean on Urinalysis for MT	B. Level of Rater
Y5. Mean on Blood Bank for MT	1. MT
Y6. Mean on Serology for MT	2. MLT
Y7. Mean on Chemistry for MT	3. CLA
Y8. Mean on Microbiology for MT	
Y9. Mean on Hematology for MT	
Y10. Mean on Urinalysis for MLT	
Y11. Mean on Blood Bank for MLT	
Y12. Mean on Serology for MLT	
Y13. Mean on Chemistry for MLT	
Y14. Mean on Microbiology for MLT	
Y15. Mean on Hematology for MLT	
Y16. Mean on Urinalysis for CLA	
Y17. Mean on Blood Bank for CLA	
Y18. Mean on Serology for CLA	
Y19. Mean on Chemistry for CLA	
Y20. Mean on Microbiology for CLA	
Y21. Mean on Hematology for CLA	
Y22. Grand Mean	

Note: Calculations followed these examples:
Y1= (Y4 + Y5 + Y6 + Y7 + Y8 + Y9)/6
Y4= (U001 + U002 + ... +U025)/25
Y22=(Y1 + Y2 + Y3)/3

The resulting design was a 3 x 2 factorial structure and it is shown in Table 3. There were no educators or chief technologists who were certified as CLA. Ratings by MT or CLA graduates were not included.

TABLE 3
A 3 X 2 FACTORIAL DESIGN WITH UNEQUAL N
AND THREE DEPENDENT VARIABLES

		FACTOR B: Level of Training	
		1 MT	2 MLT
FACTOR A: Category	1 EDUCATORS	(n=16) Y1=MT Y2=MLT Y3=CLA	(n=10) Y1=MT Y2=MLT Y3=CLA
	2 CHIEF TECHS	(n=19) Y1=MT Y2=MLT Y3=CLA	(n=3) Y1=MT Y2=MLT Y3=CLA
	3 GRADUATES	(n=0)	(n=49) Y1=MT Y2=MLT Y3=CLA

The first statistical procedure was that of frequency distributions obtained with SPSS subprogram, Frequencies, which was used to tabulate the raw input data. Since three responses were entered on each of 270 tasks for each of 100 respondents, the data were too voluminous to be tabulated or sorted manually. The subprogram Frequencies was also used to calculate descriptive statistics which gave the distributional characteristics of the dependent variables.

In a similar technique, the relationship between the respondent's category and level and the mean on each discipline area of the task analysis instrument was studied with subprogram, Breakdown, of SPSS. Overall grand means on the 270 tasks were calculated for each level of personnel rated. The grand mean on MT was termed Y1, the grand mean on MLT was termed Y2, and the grand mean on CLA was termed Y3. Means were also calculated for each of the six scientific areas. For example, the mean on the 25 urinalysis tasks for MT was termed Y4. Similar analyses were provided for each subject area for each of the three levels of personnel rated. Table 2, as indicated, contains a list of these variables and sample formulae by which the dependent variables were calculated. Oneway analyses of variance, including tests for linearity, were also provided by the Breakdown procedure.

Kerlinger (1973) advocated the use of multiple regression for ex post facto research if artificial coding was required for attribute variables such as Category and Level used in this study. Others, such as Woodward and Overall (1975), advocated the use of factorial analysis of variance, specifically the multivariate analysis of variance, termed MANOVA. MANOVA as provided by the Statistical Analysis System (Barr, et al., 1979) was used in this study.

The SPSS subprogram, ANOVA, was chosen for the factorial analysis of variance for one dependent variable. The Multiple Classification Analysis provided by ANOVA was of greater value than the information provided by the ONEWAY ANOVA of the Breakdown procedure.

Assumptions for the use of the significance tests associated with ANOVA were that (1) the sample was drawn at random, (2) each array of "Y" for the combination of "A,B" followed the normal distribution, (3) the regression was linear, and (4) all "Ys" had the same variance (Nie et al., 1975).

Discriminant function analysis, provided by a subprogram of SPSS, was chosen since, in this analysis, a regression equation was generated with a "Y" that represented group membership (Kerlinger and Pedhazur, 1973). This procedure was a reversed regression procedure in that the dependent variable, group membership, required coded values, and the discriminant function maximally "discriminated" the members of the sample. In other words, it identified the group to which the members belonged (Nie et al., 1975).

The eigenvalues and the associated canonical correlations were used to denote the relative ability of each function to separate the groups. Along with the regular procedure, the method for the stepwise selection criteria chosen was Wilks' lambda (Λ) which gave the overall multivariate F ratio for the test of group discrimination (Nie et al., 1975). In the Discriminant program the groups were the five combinations of the 3 x 2 factorial design of "A" and "B." The variables were the values for Y1, Y2, and Y3, defined above.

From the Statistical Analysis System (SAS), subprogram MANOVA was selected as the best subprogram to produce an overall test of variance and interaction (Barr et al., 1979). For this study, the 3 x 2 factorial analysis was chosen with two independent variables and three dependent variables with unbalanced cells. Since the cells were unequal, the General Linear Model (GLM) with MANOVA option was selected in lieu of MANOVA.

The MANOVA procedure is appropriate only for equal cells, but the MANOVA option of GLM is flexible enough to accommodate unbalanced designs (Barr et al., 1979). According to Kerlinger (1973), factorial analysis of variance should not be used since multiple regression is a more suitable alternative. Both multiple regression and MANOVA are, however, instances of the General Linear Model (Barr et al., 1979; Nie et al., 1975).

The measures of importance in GLM/MANOVA are analogous to those applied to correlated independent variables in regression (Wilkinson, 1975). Wilkinson indicated that MANOVA is a case of multivariate regression and the standardized regression coefficients of multiple regression are analogous to the standardized canonical coefficients of GLM/MANOVA. In addition, a measure of importance, termed estimate of treatment effect, in MANOVA, is taken from the coefficients of the coded variables of multiple regression. According to Olson (1976), the best test statistic for general use in multivariate analysis is the Pillai Trace. This statistic was produced with the SAS GLM/MANOVA procedure for this study. The subprogram automatically generated the Pillai Trace when more than one dependent variable was used (Barr et al., 1979). While the Pillai Trace was used with this procedure, as some authors have indicated, even this test statistic is not a true analog of the univariate F test used in the ANOVA procedure of SPSS and SAS (Olson, 1976).

In the GLM/MANOVA procedure, as in the discriminant function testing, the roles of the independent and dependent variables were reversed. The coded vectors were group membership and were treated as the "Y" while the actual "Ys" were treated as "Xs" or independent variables. The important point which should be noted here is that this reversal of roles by the GLM/MANOVA program was only for the analysis. Statistics generated by

GLM/MANOVA included R^2, which is somewhat analogous to the univariate F ratio, and $1 - R^2$, which is equal to Wilks' lambda. An advantage of the design was that by using it, the researcher could determine if the independent variables interacted in their effect on the dependent variables.

Additional subprograms used in this study included subprogram, Scattergram, of the _Statistical Package for the Social Sciences_. This program calculated Pearson product-moment correlation coefficients for pairs of variables and produced scatterplots of the linear relationships. The Pearson's r serves as an indicator of the goodness of fit of the linear regression as well as a measure of association which indicates the strength of the linear relationship between two variables (Nie et al., 1975). Pearson's r was calculated between Y1 and Y2, Y1 and Y3, and Y2 and Y3.

As a followup test to the two-way ANOVAs (two independent variables, A and B) performed with the SPSS ANOVA procedure, the ONEWAY ANOVA was included because of the a posteriori tests available with that procedure. To test simple main effects after ANOVA, the Duncan's Multiple Range Test and the Tukey test of Honestly Significant Difference were chosen to separate the groups. The two-way ANOVAs showed differences among groups, but these procedures could not identify which group was different.

In addition, subprogram, Reliability, of SPSS was used to test the instrument itself. While not directly used to interpret and evaluate data, Reliability was a useful procedure. This program provided a large number of matrices and coefficients for the task analysis questionnaire. The raters of the instrument were entered as variables while the ratings were entered as cases. Reliability refers to the approximation of the true score in the population. The split-half reliability was performed on MT data from the questionnaire, and the Spearman-Brown correlation was generated for the two halves of each scientific section of the questionnaire (Hull and Nie, 1979).

One additional note is required concerning calculation of the subject area scores (i.e., Y4 to Y9) of the dependent variables. One methodological problem arose in determining a functional method for calculating an easily interpretable score for each of the six areas of the task analysis instrument. Even though the rating scales were of the same length, not every person answered every task. The researcher chose not to lower a person's overall score because of the omissions. A formula was used to calulate the dependent variable score on those tasks which were completed. The formula derived to calculate the dependent variable score for each area was

$$Y = \frac{\Sigma\ (x_1 . \ . \ . \ . \ . x_n)}{n-m}$$

where $x_1 . \ . \ . \ . x_n$ equals the numerical ratings given for the level of personnel rated on each task, _n_ equals the total number of tasks in the area (i.e., 25 for urinalysis), and _m_ equals the number of tasks actually rated by the respondent.

CHAPTER IV
ANALYSIS OF DATA

Data Concerning the Instrument

Reliability Estimation

The internal consistency of each subject area of the task analysis questionnaire was estimated using the split-half and alpha reliability coefficients produced by SPSS subprogram, Reliability. The items in each section remained in their original order. The alpha coefficient was determined for each section and Table 4 presents each value for the non-split-half reliability. The first group for the split-half reliability consisted of odd numbered tasks and the second group consisted of even numbered tasks. The resulting Guttman split-half correlation coefficient was lowest for hematology and highest for blood bank. The Spearman-Brown formula, advocated by Thorndike and Hagen (1977), was applied to each split-half coefficient in order to estimate the reliability for the entire questionnaire. The values for alpha, the Guttman split-half reliability coefficient, and the Spearman-Brown coefficients were high, indicating the effective reliability of the instrument. The values for the coefficients appear in Table 5.

Using the test-retest method, Pearson product-moment correlation coefficients were calculated for the persons involved in the pilot test discussed in Chapter III. The mean for these correlation coefficients was $\underline{r}$, .75 (1,9) $\underline{p}<.05$.

TABLE 4
INTERNAL CONSISTENCY COEFFICIENTS OF TASK ANALYSIS SUBJECT AREAS

Subject Area	N of Tasks	Alpha
Urinalysis	25	.9263
Blood Bank	40	.9567
Serology	30	.9564
Chemistry	65	.9776
Microbiology	54	.9785
Hematology	56	.9720

TABLE 5
SPLIT-HALF RELIABILITY COEFFICIENTS FOR TASK ANALYSIS QUESTIONNAIRE

Subject Area	Spearman-Brown r	Guttman Split-Half	Alpha Part I	Alpha Part II	Correlation between forms
Urinalysis	.8956	.8776	.8876	.8673	.8109
Blood Bank	.9533	.9533	.9079	.9286	.9109
Serology	.8672	.9529	.9121	.9529	.7656
Chemistry	.8989	.8766	.9518	.9688	.8164
Microbiology	.9338	.9336	.9610	.9616	.8760
Hematology	.9292	.8727	.9335	.9609	.8678

Biographical Data

General

Respondents completed biographical data forms appropriate to their category. Educators and chief technologists completed identical forms while graduates completed a different form. Copies of the forms are provided in Appendix C. For chief technologists and educators, questions concerned professional certification level, years of experience, place of employment, education level, areas of expertise, and areas of responsibility. In addition, respondents were asked to indicate their county of residence in order that the researcher would have a geographical distribution of respondents. All persons in each personnel category were asked to provide the length of their experience and level of education.

Educators

The findings presented in Table 6, indicated that all educators held the generalist certification, MT(ASCP), while almost 20% held specialist certification of ASCP. All had obtained bachelor's degrees as the minimal level of education and 42% also held master's degrees.

Approximately 40% of the MT educators were employed by hospitals while all of the MLT educators were employed by community colleges. The 1977 guidelines for approved MLT programs required that colleges, as opposed to hospitals, have the primary responsibility for the administration of MLT programs (National Accrediting Agency, 1977). Adherence to these guidelines accounted for the employment by colleges of all MLT educators.

The majority of educators had at least ten years of professional experience in medical technology. All had attended continuing education meetings during the preceding year, and most of those meetings had

TABLE 6
SELECTED PROFESSIONAL CHARACTERISTICS OF LABORATORY EDUCATORS BY TYPE OF PROGRAM

Characteristics	Type of Program MT (N=16)	 MLT (N=10)	Total (N=26)	
A. Certification Level				
1. MT(ASCP)specialist	4	1	5	(19%)
2. MT(ASCP)	12	9	21	(81%)
B. Education Level				
1. Bachelor's degree	7	7	14	(54%)
2. Master's degree	8	3	11	(42%)
3. Doctor's degree	1		1	(4%)
C. Place of Employment				
1. Hospital, size C (200-300beds)	1		1	(4%)
2. Hospital, size D (>300beds)	9		9	(35%)
3. Community/Technical college		10	10	(39%)
4. University	5		5	(19%)
5. Red Cross Blood Center	1		1	(4%)
D. Mean Years of Experience				
1. From 6 to 10 years	5	6	11	(42%)
2. From 11 to 15 years	10	4	14	(54%)
3. Over 15 years	1		1	(4%)
E. Areas of Expertise				
1. Bacteriology	4	4	8	(31%)
2. Chemistry	3	3	6	(23%)
3. Hematology	6	3	9	(35%)
4. Immunohematology	3		3	(11%)
F. Areas of Responsibility				
1. Primary--Teaching	16	10	26	(100%)
2. Secondary				
a. inventory/ordering	3	3	6	(23%)
b. quality control	3	3	6	(23%)
c. administration	2	3	5	(19%)
d. research	1		1	(4%)
G. Continuing Education				
1. Attended 2 meetings last year	9	7	16	(61%)
2. Attended 5 meetings last year	7	3	10	(39%)

concerned education, per se. Educators appeared to be familiar with all three levels of certified personnel since an average of 13% of MLTs and 12% of CLAs were employed as lab assistants or staff technicians on the staffs of the various programs. The educators may have gained familiarity with each level of laboratorian because of having attended education sessions at the state medical technology meetings (personal communication).

Chief Technologists

The majority of chief technologists were certified as MTs (ASCP) and a few were also certified as specialists by ASCP. Another eight percent were certified only by a government proficiency examination (HEW), and one group held certification by the American Medical Technologists (AMT). Almost all chief technologists held bachelor's degrees even though many were trained more than 20 years ago when college degrees were not required for MT training. Four of the chief technologists held master's degrees. The small percentage of those having no degree were certified by HEW or AMT. Results of the biographical data for chief technologists are presented in Table 7.

Most of the chief technologists had worked more than 15 years in the profession of clinical laboratory sciences, and those who worked in smaller hospitals had the greatest amount of experience.

More than half of the chief technologists classified their area of specialty as management while those from small hospitals indicated they worked in all clinical areas and performed routine tests. Responsibilities of chief technologists encompassed virtually all of the areas listed on the biographical data form and many of the chief technologists indicated they participated in clinical teaching of

TABLE 7
SELECTED PROFESSIONAL CHARACTERISTICS OF CHIEF TECHNOLOGISTS BY SIZE OF HOSPITAL

Characteristics	Size of Hospital				Total	
	A N=6	B N=6	C N=4	D N=8	N=24	
A. Certification Level						
1. MT(ASCP)specialist			2	2	4	(17%)
2. MT(ASCP)	3	5	2	6	16	(67%)
3. MT(HEW)	1	1			2	(8%)
4. MT(AMT)	2				2	(8%)
B. Education Level						
1. No degree		1	1		2	(8%)
2. Bachelor's degree	5	5	3	5	18	(75%)
3. Master's degree	1			3	4	(17%)
C. Mean Years of Experience	17	19	11	12		
D. Areas of Practice						
1. Work in all areas	3	1	1	2	7	(29%)
2. Management	3	2	3	6	14	(58%)
3. Chemistry		3			3	(13%)
E. Responsibilities						
1. Scheduling	3	2	3	2	10	(42%)†
2. Routine tests	5	6	1	6	18	(75%)†
3. Inventory/ordering	6	6	3	8	23	(96%)†
4. Quality Control	3	4	3	8	18	(75%)†
5. Teaching	4	3	2	4	13	(54%)†
F. Continuing Education						
1. Attended no meetings	2	2		1	5	(21%)
2. Attended ≤3 meetings	2	1		1	4	(17%)
3. Attended $\overline{5}$ meetings	1	1	4	4	10	(41%)
4. Attended >6 meetings	1	2		2	5	(21%)

†most technologists indicated >1 area

laboratory students. More than 40% of the chief technologists had attended from three to five continuing education meetings during the preceding year. The most popular sessions attended were those relating to management.

The request to complete a questionnaire concerning task analyses of three levels of laboratorians should have come as no surprise to chief technologists since most worked with representatives of each level of certified personnel. The mean number of MT(ASCP) individuals for size A hospitals was 4; for size B hospitals, also 4; for size C hospitals, 11; and for size D hospitals, 21. The mean number of MLT(ASCP) personnel employed in each size hospital was 3, 2, 4, and 12 for size A, size B, size C, and size D hospitals, respectively. A mean of one CLA(ASCP) worked in each size hospital.

Graduates

Questions on the MLT graduates' biographical data form were somewhat different (see Appendix C). Since some of the graduates had been out of school (MLT program) for five years, the researcher attempted to determine if those graduates were still working in a field related to their training at the time of the study. Additional items concerned the size of hospital in which MLTs worked, the geographical location, the type of work, responsibilities, and specialty. The amount, if any, of education obtained following graduation from Sandhills was also requested on the form.

Almost all MLT graduates were working in laboratory medicine when they completed the survey instrument. Those few (three) who had left laboratory work were either going to school or rearing children.

The first place of employment following graduation from the Sandhills program was a hospital of more than 200 beds for 48% of the MLTs. The same number were working in a similar setting at the time of the survey. An implication from those data was that many of the MLTs had remained in the same place of employment. Almost 90% of the graduates had remained in North Carolina in the same general vicinity (100-mile radius) as the place of training. The zip codes which the graduates provided assisted the researcher in gaining an idea of the geographical distribution. The general distribution showed that the majority of graduates worked in towns of fewer than 25,000 people. The mean number of years of experience for the graduates was three.

The specialties in which graduates worked included all general areas as well as some specific areas such as radioimmunoassay. Many graduates indicated their major responsibilities encompassed several areas presented in Table 8.

Thirteen of the graduates had begun to pursue a bachelor's degree and five of them had attained the degree. More than half of the graduates had attended continuing education meetings during the preceding year.

When asked to evaluate the profession of laboratory medicine in general and their own contributions to it in particular, 84% of the graduates were confident in their performance of tasks involved in laboratory work. The majority also indicated that MLTs deserve more recognition for their role in clinical laboratory sciences.

All categories

For all categories of respondents, the mean number of years of experience was 10. For chief technologists, the mean was 15; for

TABLE 8
SELECTED BIOGRAPHICAL DATA ON MLT GRADUATES

Characteristics	N of Responses	Relative Number
A. Working in laboratory medicine	46	94%
B. Unemployed due to		
1. Family responsibilities	1	2%
2. Continuing college	2	4%
C. Place of first employment following MLT school		
1. Hospital, < 100 beds	8	17%
2. Hospital, 100 to 200 beds	11	24%
3. Hospital, > 200 beds	22	48%
4. Clinic/Physician's office	4	9%
5. Reference laboratory	1	2%
D. Place of current employment		
1. Hospital, <100 beds	7	15%
2. Hospital, 100 to 200 beds	7	15%
3. Hospital, >200 beds	22	48%
4. Clinic/Physician's office	9	20%
5. Reference laboratory	1	2%
E. Geographical location by number of people in city		
1. <5,000	1	2%
2. 5,000 to 10,000	14	29%
3. 10,000 to 25,000	14	29%
4. 25,000 to 50,000	11	22%
5. 50,000 to 200,000	3	6%
6. >200,000	6	12%
F. Geographical location by state		
1. North Carolina	43	88%
2. Arizona	1	2%
3. California	2	4%
4. Colorado	1	2%
5. Illinois	1	2%
6. Ohio	1	2%

(Continued)

Table 8 - Continued

Characteristics	N of Responses	Relative Number
G. Years of experience in laboratory medicine		
1. <1 year	4	9%
2. 1 to 3 years	16	35%
3. 3 to 5 years	19	41%
4. >5 years	7	15%
H. Additional education		
1. Some college courses	8	16%
2. Bachelor's degree	5	10%
3. Master's degree	1	2%
4. None yet	28	58%
5. None, no plans	7	14%
I. Primary areas of practice		
1. Work in all areas	20	44%
2. Bacteriology	3	7%
3. Blood Bank	3	7%
4. Chemistry	2	4%
5. Hematology	6	13%
6. Management	2	4%
7. Serology	2	4%
8. Urinalysis	4	9%
9. RIA	1	2%
10. EKG	1	2%
11. Education	2	4%
J. Primary responsibilities		
1. Combination of a. routine tests b. inventory/ordering c. quality control d. phlebotomy	18	39%
2. Floater	16	35%
3. Section head	12	26%
K. Attended at least one continuing education meeting in last 12 months	31	67%
L. Feelings concerning laboratory medicine		
1. " I feel confident in my laboratory work."	41	84%
2. " I can do the work, but I could have used more training."	6	12%
3. "The profession is good, but MLTs deserve more recognition."	29	63%

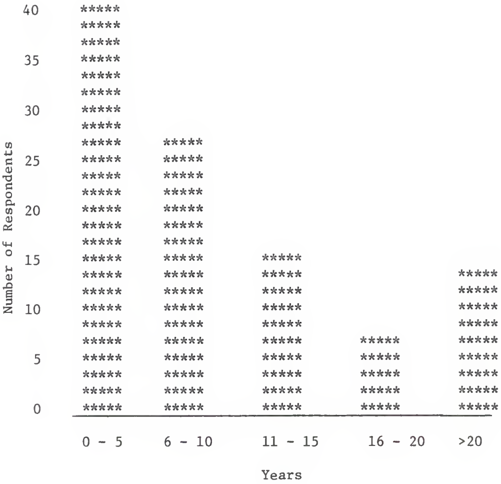

Figure 1
Mean years of experience for all respondents

educators, the mean was 11; for graduates, the mean was 3. Of the 100 respondents, 40% had worked from zero to five years, and this group contained most of the graduates. Fewer than 10 respondents had worked from 16 to 20 years. When viewed in five-year increments, a greater disparity was seen in the group which had worked from zero to five years than the other groups. The disparity was explained since that group contained many graduates. The group which had worked more than 16 years was composed of one educator and a dozen chief technologists. Figure 1 is a histogram presentation of this distribution.

Statistical Data

Analysis of Each Task

Response frequencies and percentages for each task for all groups as a whole are reported in Table 35 in Appendix F. Task frequencies for one area, serology, are reported in Table 9 for chief technologists and graduates. This particular area appeared to vary among categories of raters, and was, therefore, included. The total and subject area task means and standard deviations by category are included in Table 10. Because the tasks were naturally grouped into one of six subject areas in the initial questionnaire, the researcher chose not to reduce the 270 tasks by factor analysis. The six subject areas represented a workable list of "factors."

Hypothesis Testing

Hypothesis 1. The first hypothesis asked if any significant differences were observed in perceptions by the three categories of MT competence. ANOVAs on MT were performed with and without the regression option (Hull and Nie, 1979) which provided a means for the researcher to determine if the dependent score for MT could be "predicted" from the independent

TABLE 9
FREQUENCY DISTRIBUTIONS ON SEROLOGY TASKS FOR MLT AS PERCEIVED BY CHIEF TECHNOLOGISTS AND MLT GRADUATES

Serology Task		MLT Rating							
		Chief Technologists (N=22)*				MLT Graduates (N=46)*			
Number	Keywords	4	3	2	1	4	3	2	1
S066	VDRL, RPR	14	7	1		40	5		1
S067	quan. VDRL	10	10	2		31	9	3	2
S068	FTA-Abs	2	9	6	4	8	22	8	8
S069	send specimen	19	3			45	1		
S070	calibrate rotator	14	4	3	1	31	12	3	
S071	calibrate pipette	8	8	5	1	30	12	4	
S072	serial dilution	7	13	2		34	8	3	
S073	CRP-slide	14	8			38	8		
S074	RA-slide	17	5			41	5		
S075	cold agglutinin	12	9	1		40	6		
S076	ASOT	12	8	2		37	8	1	
S077	Streptozyme	13	8	1		40	6		
S078	Mono, screen	15	7			44	2		
S079	Mono, differential	9	7	6		26	12	7	1

(Continued)

*where row totals do not equal N, values were missing

Table 9 - Continued

Serology Task		MLT Rating							
		Chief Technologists ($\underline{N}$=22)*				MLT Graduates ($\underline{N}$=46)*			
Number	Keywords	4	3	2	1	4	3	2	1
S080	latex-HCG	16	6			45	1		
S081	HAI-HCG	13	6	2		33	10	1	2
S082	RIA-HCG	5	5	10	1	12	19	11	4
S083	cell suspensions	5	12	4	1	29	15	2	
S084	LE slide test	10	8	4		30	11	3	2
S085	ANA test	3	9	6	3	11	18	9	8
S086	ANA patterns	3	5	8	5	9	14	15	8
S087	febrile	8	10	4		36	9		
S088	Igs-nephelometry	2	6	10	3	2	14	12	17
S089	HAI-rubella	4	8	6	3	21	17	4	4
S090	RIA-HB_sAg	2	11	6	3	10	14	12	10
S091	microtiter-thyroglb.	7	7	4	1	14	11	5	5
S092	CF-viral	6	5	7	2	18	12	2	4
S093	fungal Abs	6	7	5	2	17	12	2	4
S094	CH_{50}	6	7	5	1	13	15	2	5
S095	C_3, C_4	4	9	6		18	11	3	3
Mean percentage		41.6%	35.5%	18.1%	4.8%	60.8%	24.1%	8.5%	6.6%

*where row totals do not equal $\underline{N}$, values were missing

TABLE 10
TOTAL AND SUBJECT AREA SCORE MEANS AND STANDARD DEVIATIONS BROKEN DOWN BY EDUCATORS(1), CHIEF TECHNOLOGISTS(2), AND MLT GRADUATES(3)

Subject Area	N of Tasks	Category of Rater	MT		MLT		CLA	
			$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Urinalysis	25	1	3.94	(.24)	3.51	(.39)	2.91	(.66)
		2	3.72	(.18)	3.22	(.35)	2.51	(.68)
		3	3.84	(.37)	3.51	(.44)	2.98	(.64)
Blood Bank	40	1	3.85	(.41)	3.13	(.51)	2.52	(.78)
		2	3.84	(.33)	2.99	(.53)	2.16	(.86)
		3	3.75	(.44)	3.35	(.49)	2.52	(.65)
Serology	30	1	3.87	(.31)	3.39	(.44)	2.87	(.59)
		2	3.59	(.46)	3.18	(.59)	2.35	(1.27)
		3	3.63	(.42)	3.28	(.48)	2.69	(.61)
Chemistry	65	1	3.84	(.26)	3.23	(.36)	2.55	(.60)
		2	3.61	(.44)	3.08	(.54)	1.99	(.72)
		3	3.66	(.44)	3.27	(.51)	2.50	(.64)
Microbiology	54	1	3.94	(.27)	3.32	(.44)	2.68	(.66)
		2	3.65	(.50)	3.20	(.68)	2.15	(.82)
		3	3.67	(.42)	3.35	(.53)	2.56	(.63)
Hematology	56	1	3.94	(.26)	3.53	(.42)	2.99	(.63)
		2	3.71	(.37)	3.07	(.48)	2.41	(.85)
		3	3.79	(.42)	3.44	(.43)	2.84	(.59)
Total	270	1	3.90	(.28)	3.35	(.36)	2.72	(.54)
		2	3.68	(.34)	3.05	(.47)	2.28	(.77)
		3	3.71	(.38)	3.37	(.43)	2.68	(.56)
Grand Mean by all			3.76	(.33)	3.29	(.42)	2.59	(.62)

variables, the categories and levels of raters. The summary table for ANOVA for MT rating is presented in Table 11. The means on Y1, overall rating for MT, were 3.90 for educators, 3.68 for chief technologists, and 3.71 for MLT graduates. Probability levels were set at the 95% confidence limits ($p < .05$) for all statistical programs. As shown in Table 11, differences in main effects were not observed for MT.

SPSS subprogram ANOVA provided a Multiple Classification Analysis table for tests of significance of main effects. The data from this analysis allowed the researcher to ascertain sources of variance. The procedure provided Multiple R and Multiple R^2 statistics which assisted the researcher in determining the exact nature of differences in category. The Multiple Classification Analysis in Table 12 showed no significant differences in ratings for the MT level, and Hypothesis 1 was retained.

Hypothesis 2. Hypothesis 2 indicated that no significant differences in perceptions of competence by educators, chief technologists, or graduates exist for the MLT ratings. According to data in Table 11, the F ratios were significant for main effects for the rating of MLTs. The F value allowed the researcher to show that at least one group of raters was different in their perceptions of MLTs from at least one other group. In order to ascertain the source of variance, the researcher consulted the Multiple Classification Analysis table (Table 12). The means on Y2, the overall MLT rating, were 3.35 for educators, 3.05 for chief technologists, and 3.37 for MLT graduates. The Multiple Classification Analysis showed that for the MLT, educators and graduates differed from chief technologists, who accounted for most of the variance.

To obtain additional data to confirm the source of variance, post hoc tests including Duncan's Multiple Range Test and Tukey's Honestly

TABLE 11
ANOVA SUMMARY TABLE FOR OVERALL RATINGS OF MT, MLT, AND CLA BY CATEGORY (A) AND LEVEL (B) OF RESPONDENT

	Source of Variation	SS	df	MS	F
MT RATING	Main Effects on Y1	.665	3	.222	1.871
	A	.609	2	.304	2.570
	B	.025	1	.025	.208
	Interaction (2-way)	.177	1	.177	4.495
	A B	.177	1	.177	4.495
	Explained	.842	4	.210	1.777
	Residual	9.001	76	.118	
	Total	9.843	80	.123	
MLT RATING	Main Effects on Y2	1.606	3	.535	2.982*
	A	1.292	2	.646	3.598*
	B	.082	1	.082	.456
	Interaction (2-way)	.010	1	.010	.055
	A B	.010	1	.010	.055
	Explained	1.616	4	.404	2.251
	Residual	13.820	77	.179	
	Total	15.436	81	.191	
CLA RATING	Main Effects on Y3	3.930	3	1.310	3.425*
	A	3.926	2	1.963	5.132*
	B	1.358	1	1.358	3.550
	Interaction (2-way)	.054	1	.054	.141
	A B	.054	1	.054	.141
	Explained	3.984	4	.996	2.604*
	Residual	29.072	76	.383	
	Total	33.056	80	.413	

*$p<.05$

TABLE 12
MULTIPLE CLASSIFICATION ANALYSIS OF ANOVA STATISTICS ON OVERALL MT, MLT, AND CLA RATINGS BY CATEGORY(A) AND LEVEL(B) OF RESPONDENT

	Variable + Level	N	Unadjusted Deviation	Eta	Adjusted Deviation	Beta	$\overline{X}$
MT RATING	A. Category						
	1. Educators	24	.14		.13		3.88
	2. Chief Techs	21	-.07		-.10		3.67
	3. Graduates	36	-.05		-.03		3.69
				.26		.25	
	B. Level						
	1. MT	32	.03		.03		3.77
	2. MLT	49	-.02		.02		3.72
				.08		.080	
	Multiple $\underline{R}^2$					.068	
	Multiple $\underline{R}$					.260	
	Grand Mean						3.74
MLT RATING	A. Category						
	1. Educators	24	.06		.04		3.34
	2. Chief Techs	21	-.23		-.28		3.04
	3. Graduates	37	.09		.13		3.37
				.31		.38	
	B. Level						
	1. MT	32	-.08		.06		3.01
	2. MLT	50	.05		-.04		3.22
				.14		.110	
	Multiple $\underline{R}^2$					.323	
	Multiple $\underline{R}$					.110	
	Grand Mean						3.27
CLA RATING	A. Category						
	1. Educators	24	.12		.05		2.69
	2. Chief Techs	21	-.30		-.49		2.26
	3. Graduates	36	.09		.25		2.66
				.28		.47	
	B. Level						
	1. MT	32	-.01		.24		2.55
	2. MLT	49	.01		-.16		2.57
				.01		.310	
	Multiple $\underline{R}^2$					.119	
	Multiple $\underline{R}$					.345	
	Grand Mean						2.56

Significant Difference (Winer, 1971), were performed along with a ONEWAY ANOVA on category and Y2. As shown in Table 13, the F ratios for the ONEWAY procedure were also significant for the MLT rating. Duncan's test (Table 14) produced two subsets which indicated that group 2, chief technologists, differed significantly from group 1, educators, and group 3, graduates. The means were also different using Tukey's test, which according to Huberty (1976), is a more powerful test. Since the dependent variable for MLT was affected by different categories of raters, Hypothesis 2 was rejected.

Hypothesis 3. Hypothesis 3 concerned significant differences in the perception of the degree of competence of CLAs who had one year of experience. All raters were included to determine if differences existed among raters, as in the first two hypotheses. As shown in Table 11, the CLA was also subjected to a two-way ANOVA. The means on Y3, overall rating on CLA were 2.72 for educators, 2.28 for chief technologists, and 2.68 for MLT graduates. Differences in main effects were observed for the CLA rating as indicated by the significant F ratio. The source of the variance was determined to be category (educator, chief technologist, MLT graduate) since differences in level (MT, MLT) and the interaction of category and level were not significant. According to the information in the Multiple Classification Analysis shown in Table 12, chief technologists differed from both educators and MLT graduates. The table also included a differentiation between levels of training, but those differences were not a significant source of variance for Y3.

The CLA rating (Y3) was also subjected to a ONEWAY ANOVA by category. The source of variance, shown in Table 11, was category.

TABLE 13
SUMMARY OF ONEWAY STATISTICS FOLLOWING ANOVA ON MAIN EFFECTS FOR CATEGORY(A) ON MLT AND CLA RATINGS

	Source	SS	df	MS	F
MLT RATING	MLT Y2				
	Between Levels of A	1.5240	2	.7620	4.327*
	Within Groups	13.9117	79	.1761	
	Total	15.4358	81		
CLA RATING	CLA Y3				
	Between Levels of A	2.5723	2	1.2862	3.291*
	Within Groups	30.4840	78	.3908	
	Total	33.0563	80		

*p <.05

TABLE 14
MULTIPLE RANGE TESTS OF VARIANCE IN ANALYSIS OF MAIN EFFECTS OF MLT AND CLA RATINGS BY GROUPS OF CATEGORY(A): EDUCATORS(1), CHIEF TECHNOLOGISTS(2), AND GRADUATES(3)

	Duncan's Homogeneous Subsets			Tukey's HSD				
MLT RATING	Y2			Mean	Group	Gp2	Gp1	Gp3
	Subset 1			3.0435	2			
	Group	2*		3.3361	1	*		
	Mean	3.0435		3.3664	3	*		
	Subset 2							
	Group	1	3					
	Mean	3.3361	3.3664					
	Duncan's Homogeneous Subsets			Tukey's HSD				
CLA RATING	Y3			Mean	Group	Gp2	Gp1	Gp3
	Subset 1			2.2628	2		+	+
	Group	2*		2.6875	1	+		+
	Mean	2.2628		2.6555	3	+	+	
	Subset 2							
	Group	3	1					
	Mean	2.6555	2.6875					

*Group 2 was different (p<.05) than Groups 1 and 3
+No two groups were significantly different (p .05)

This source was confirmed from the F ratios of the ONEWAY ANOVA shown in Table 13. Duncan's Multiple Range Test shown in Table 14, created two homogeneous subsets. One contained chief technologists as a group, and the other contained educators and graduates as a group. Tukey's test did not, however, agree with data from the Duncan procedure. Significant differences on Y3, overall rating on CLA, were observed among categories since chief technologists had different perceptions than those held by educators or graduates. Based on data from the two-way ANOVA, the ONEWAY ANOVA, and Duncan's test, Hypothesis 3 was rejected.

Hypothesis 4. According to Hypothesis 4, perceptions of competence in the blood banking area for MT were believed by educators to be significantly higher than the perceptions by either chief technologists or MLT graduates. The mean on the 40 blood bank tasks for MT was calculated by the computer program and subsequently subjected to a two-way ANOVA by category and level of respondent. The summary table, presented in Table 15, indicated no significant difference on blood banking by category of rater. The Multiple Classification Analysis, also provided by ANOVA, failed to separate the groups of raters. The adjusted deviation scores provided in Table 16 diminished as chief technologists were included after educators. The decreasing score suggested that the two groups were related. When graduates were included after chief technologists, the deviation scores increased, suggesting that group (graduates) was different. The difference was not, however, supported by a significant F ratio from the two-way ANOVA data. Differences for MT were not significant. Hypothesis 4 was, therefore, rejected.

TABLE 15
ANOVA SUMMARY TABLE FOR BLOOD BANK RATING OF MT, MLT, AND CLA BY CATEGORY(A) AND LEVEL(B) OF RESPONDENT

	Source of Variation	SS	df	MS	F
MT RATING	Main Effects on Y5	.212	3	.071	.527
	A	.204	2	.102	.759
	B	.033	1	.033	.245
	Interaction (2-way)	.195	1	.195	1.450
	A B	.195	1	.195	1.450
	Explained	.407	4	.102	.758
	Residual	10.202	76	.134	
	Total	10.609	80	.133	
MLT RATING	Main Effects on Y11	2.204	3	.735	3.059*
	A	1.320	2	.660	2.747
	B	.062	1	.062	.259
	Interaction (2-way)	.024	1	.024	.100
	A B	.024	1	.024	.100
	Explained	2.228	4	.557	2.319
	Residual	18.497	77	.240	
	Total	20.725	81	.256	
CLA RATING	Main Effects on Y17	3.522	3	1.174	2.168
	A	3.511	2	1.756	3.242*
	B	1.782	1	1.782	3.289
	Interaction (2-way)	.002	1	.002	.004
	A B	.002	1	.002	.004
	Explained	3.524	4	.881	1.627
	Residual	41.161	76	.542	
	Total	44.685	80	.559	

*p<.05

TABLE 16

MULTIPLE CLASSIFICATION ANALYSIS OF ANOVA STATISTICS ON BLOOD BANK RATINGS OF MT, MLT, AND CLA BY CATEGORY(A) AND LEVEL(B) OF RESPONDENT

	Variable + Level	N	Unadjusted Deviation	Eta	Adjusted Deviation	Beta	$\overline{X}$
MT RATING	A. Category						
	1. Educators	24	.07		.05		3.72
	2. Chief Techs	21	-.06		-.09		3.60
	3. Graduates	36	-.01		.01		3.65
				.13		.15	
	B. Level						
	1. MT	32	.01		.04		3.67
	2. MLT	49	-.01		.02		3.65
				.03		.08	
	Multiple R^2					.08	
	Multiple R					.02	
	Grand Mean						3.66
MLT RATING	A. Category						
	1. Educators	24	-.08		-.10		3.06
	2. Chief Techs	21	-.21		-.25		2.93
	3. Graduates	37	.17		-.20		3.31
				.32		.38	
	B. Level						
	1. MT	32	-.13		.05		3.01
	2. MLT	50	.08		-.03		3.22
				.21		.080	
	Multiple R^2					.106	
	Multiple R					.326	
	Grand Mean						3.14
CLA RATING	A. Category						
	1. Educators	24	-.05		-.13		2.26
	2. Chief Techs	21	-.20		-.42		2.10
	3. Graduates	36	.15		.33		2.45
				.20		.42	
	B. Level						
	1. MT	32	-.01		.28		2.29
	2. MLT	49	.01		-.18		2.31
				.02		.300	
	Multiple R^2					.079	
	Multiple R					.281	
	Grand Mean						2.30

Hypothesis 5. Hypothesis 5 assumed that chief technologists rated MLTs lower than educators or MLT graduates rated them. As in the testing of Hypothesis 4, the mean on blood bank tasks for MLT (Y11) was computed for each respondent and then was examined by a two-way ANOVA. The source of significant variance was main effects (either category or level), but the specific contributions to variance by category, level, or interaction of category and level, failed to produce significant results at the $p<.05$ level (see Table 15). The Multiple Classification data shown in Table 16 provided support to separate the categories into educators and chief technologists as one group and graduates as a second group. Data from the ONEWAY ANOVA, provided in Table 17, also showed variance among categories.

The homogeneous subsets created by Duncan's Multiple Range Test, shown in Table 18, supported the findings of the ONEWAY ANOVA. In the first subset, graduates were separated from educators and chief technologists. In the second subset, chief technologists were different from both educators and graduates. Tukey's test supported Duncan's first subset by grouping graduates and educators together. The chief technologists were significantly different from the other categories. The mean rating on blood bank tasks by chief technologists was 2.93; the mean for educators was 3.06; the mean for graduates was 3.31. The lower mean for chief technologists was significant and Hypothesis 5 was retained.

Hypothesis 6. Hypothesis 6 concerned the perceptions of competence by educators, chief technologists, and MLT graduates of CLAs on blood bank tasks. The hypothesis indicated no differences in competence of CLAs as perceived by categories of raters. The mean on blood bank

TABLE 17
SUMMARY OF POST HOC STATISTICS FOR ANOVA ON MAIN EFFECTS FOR CATEGORY(A) ON BLOOD BANK TASKS FOR MLT AND CLA

	Source	SS	df	MS	F
MLT RATING	Y11				
	Between levels of A	2.1422	2	1.0711	4.55*
	Within groups	18.4831	79	.2352	
	Total	20.7253	81		
CLA RATING	Y17				
	Between levels of A	1.7408	2	.8704	1.581
	Within groups	42.9450	78	.5506	
	Total	44.6858	80		

*p<.05

TABLE 18
MULTIPLE RANGE TESTS OF SIGNIFICANT MAIN EFFECTS AFTER ANOVA ON BLOOD BANK TASKS FOR MLT AND CLA BY EDUCATORS(1), CHIEF TECHNOLOGISTS(2), AND GRADUATES(3)

MLT RATING

Duncan's Homogeneous Subsets
Y11
Subset 1

Group	2	1
Mean	2.9298	3.0583

Subset 2

Group	1	3
Mean	3.0583	3.3088

Tukey's HSD

Mean	Group	Gp 2	Gp 1	Gp 3
2.9298	2			
3.0583	1	*		
3.3088	3	*		

CLA RATING

Duncan's Homogeneous Subsets
Y17
Subset 1

Group	2	1	3
Mean	2.088	2.257	2.454

Tukey's HSD

Mean	Group	Gp 2	Gp 1	Gp 3
2.0988	2			
2.2573	1	*		
2.4535	3			

*indicates significant (p<.05)difference between groups tasks was compared for each of the respondents using a two-way ANOVA on the 3 x 2 factorial design. The main effects, shown in Table 15, were not significant together, but the category of raters was shown to be significant. The level of personnel and the interaction of category and level were not significant.

Since the main effect of category was significant, it was examined with the ONEWAY procedure and its a posteriori tests. The Multiple Classification Analysis, shown in Table 16, suggested that graduates differed from educators and chief technologists in their perceptions of the competence of CLAs. When perceptions of chief technologists were examined after the effect of educators, the unadjusted deviation score decreased showing that these two categories were related. When the effect of graduates was added, the deviation increased, showing an unrelated group. The significant F ratio for category was obtained with the two-way ANOVA, but it was not supported by the tests for simple main effects (see Table 17).

Duncan's Multiple Range Test included all three groups in the same subset. Tukey's procedure indicated, however, that chief technologists were different from educators but related to graduates. Since most of the a posteriori tests indicated homogeneity of variance across levels of category, and since no significant F values were confirmed, Hypothesis 6 was retained.

Hypothesis 7. Hypothesis 7, while similar to the previous hypotheses concerning blood banking, concerned a different subject area, serology. Ratings of the perceptions of competence of MTs in serology were thought to be homogeneous among categories of raters. The summary of the ANOVA statistics is provided in Tables 19 and 20.

TABLE 19
ANOVA SUMMARY TABLE FOR SEROLOGY RATING OF MT, MLT, AND CLA BY CATEGORY(A) AND LEVEL(B) OF RESPONDENT

	Source of Variation	SS	df	MS	F
MT RATING	Main Effects on Y6	.993	3	.331	1.712
	A	.975	2	.487	2.522
	B	.000	1	.000	.001
	Interaction (2-way)	.344	1	.344	1.779
	A B	.344	1	.344	1.779
	Explained	1.336	4	.334	1.729
	Residual	14.683	76	.193	
	Total	16.019	80	.200	
MLT RATING	Main Effects on Y12	1.393	3	.464	1.981
	A	1.291	2	.645	2.752
	B	.033	1	.033	.139
	Interaction (2-way)	.284	1	.284	1.213
	A B	.284	1	.284	1.213
	Explained	1.677	4	.419	1.789
	Residual	18.054	77	.234	
	Total	19.731	81	.244	
CLA RATING	Main Effects on Y18	4.280	3	1.427	2.891*
	A	4.219	2	2.110	4.275*
	B	1.422	1	1.422	2.881
	Interaction (2-way)	.298	1	.298	.603
	A B	.298	1	.298	.603
	Explained	4.577	4	1.144	2.319
	Residual	37.506	76	.494	
	Total	42.083	80	.526	

*p<.05

TABLE 20
MULTIPLE CLASSIFICATION ANALYSIS OF ANOVA
STATISTICS ON SEROLOGY RATINGS OF MT,
MLT, AND CLA BY CATEGORY(A) AND
LEVEL(B) OF RESPONDENT

	Variable + Level	N	Unadjusted Deviation	Eta	Adjusted Deviation	Beta	$\overline{X}$
MT RATING	A. Category						
	1. Educators	24	.17		.17		3.72
	2. Chief Techs	21	-.10		-.09		3.60
	3. Graduates	36	-.06		-.06		3.65
				.25		.25	
	B. Level						
	1. MT	32	.02		-.00		3.67
	2. MLT	49	-.01		.00		3.65
				.03		.010	
	Multiple R^2					.062	
	Multiple $\overline{R}$					.249	
	Grand Mean						3.66
MLT RATING	A. Category						
	1. Educators	24	.13		.12		3.39
	2. Chief Techs	21	-.21		-.24		3.05
	3. Graduates	37	.03		.06		3.29
				.26		.29	
	B. Level						
	1. MT	32	-.04		.04		3.21
	2. MLT	50	.03		-.02		3.29
				.07		.060	
	Multiple R^2					.071	
	Multiple $\overline{R}$					.266	
	Grand Mean						3.26
CLA RATING	A. Category						
	1. Educators	24	.21		.13		2.85
	2. Chief Techs	21	-.29		-.48		2.35
	3. Graduates	36	.03		.20		2.68
				.26		.40	
	B. Level						
	1. MT	32	.03		.25		2.68
	2. MLT	49	-.02		-.16		2.62
				.04		.280	
	Multiple R^2					.102	
	Multiple $\overline{R}$					.319	
	Grand Mean						2.65

No significant differences occurred across levels of category for MT serology competence as assessed by the two-way ANOVA. The deviation scores of the Multiple Classification Analysis of Table 20 failed to discriminate among the categories since each level that was added decreased the deviation score. The means on serology tasks for MT were 3.72 for educators, 3.60 for chief technologists, and 3.65 for graduates. Means were equal between levels of training as well (MT=3.67, MLT=3.65). Hypothesis 7, which concerned homogeneity of means on serology tasks across categories, was retained.

Hypothesis 8. Hypothesis 8 suggested that MLTs were rated lower on serology tasks by their peers (MLT graduates) than by chief technologists. The two-way ANOVA failed to indicate those suggested differences. Data from the Multiple Classification Analysis did, however, provide information for supporting separation of the two groups. Since some separation of groups occurred, the researcher conducted a ONEWAY ANOVA and its post hoc tests. The ONEWAY procedure failed to produce a significant F ratio.

Duncan's Multiple Range Test, shown in Table 22, separated the chief technologists and graduates from educators. It also separated the educators and MLT graduates from chief technologists. These results and the results of the ONEWAY ANOVA (Table 21) were not significant at the $p<.05$ level. Sufficient data were not obtained to allow separation of the chief technologists from the graduates. Tukey's test separated the chief technologists from the MLT graduates but not from the educators. The separation was significant at the $p<.05$ level. As additional supportive data, the researcher prepared tables of frequency distributions of serology tasks for chief technologists and

TABLE 21
SUMMARY OF POST HOC STATISTICS FOR ANOVA ON MAIN EFFECTS FOR CATEGORY(A) ON SEROLOGY TASKS FOR MLT AND CLA

Source	SS	df	MS	F
Y12				
Between levels of A	1.3605	2	.6802	2.925
Within groups	18.3707	79	.2325	
Total	19.7311	81		
Y18				
Between levels of A	2.8577	2	1.4289	2.841
Within groups	39.2258	78	.5029	
Total	42.0835	80		

TABLE 22
MULTIPLE RANGE TESTS OF SIGNIFICANT MAIN EFFECTS AFTER ANOVA ON SEROLOGY TASKS FOR MLT AND CLA

Duncan's Homogeneous Subsets
Y12

Subset 1		
Group	2	3
Mean	3.0492	3.2919
Subset 2		
Group	3	1
Mean	3.2919	3.3875

Tukey's HSD

Mean	Group	Gp 2	Gp 3	Gp 1
3.0492	2			
3.2919	3	*		
3.3875	1			

Duncan's Homogeneous Subsets
Y18

Subset 1		
Group	2	3
Mean	2.3540	2.6796
Subset 2		
Group	3	1
Mean	2.6796	2.8528

Tukey's HSD

Mean	Group	Gp 2	Gp 3	Gp 1
2.3540	2			
2.6796	3	*		
2.8528	1			

*indicates significant ($p<.05$) difference between groups graduates. This distribution was shown in Table 9. The mean percentage of ratings was calculated from distributions over each of the four items of the rating scale. For chief technologists, only 42% of the ratings were the highest point, "utmost competence." The MLT graduates rated the MLT higher by allocating 61% of the score to "utmost competence." The mean for chief technologists on serology ratings for MLT was 3.05, and the mean for MLT graduates on serology ratings for MLT was 3.29. Since the ratings by graduates were almost 20% higher and since Tukey's test separated MLT graduates from chief technologists, Hypothesis 8 was rejected.

Hypothesis 9. Competence of CLAs on serology tasks was evaluated by Hypothesis 9, which indicated that ratings were homogeneous for all groups. The two-way ANOVA procedure showed heterogeneity for main effects (Table 19) and for category. No differences were observed for the main effect of level or for the interaction. The Multiple Classification data presented in Table 20 separated the perceptions by MLT graduates from those of chief technologists and educators. Likewise, the MLT level was separated from the MT level.

A ONEWAY ANOVA with post hoc tests was performed on the data since differences were observed between groups. The resulting F ratio was not significant between levels of category, as shown in Table 21. Duncan's subsets, however, grouped educators and MLT graduates in one subset and chief technologists and MLT graduates in the second subset. Tukey's test separated chief technologists from MLT graduates. Group means for CLA on serology tasks were homogeneous (educators=2.85; chief technologists=2.35; MLT graduates=2.68). With no data to support the heterogeneity of group means, Hypothesis 9 was retained.

Hypothesis 10. Hypothesis 10 suggested that the category of rater could not be predicted by separate ratings of MT, MLT, and CLA. As an example, the category, educators, could not be predicted by the ratings on Y1, the primary dependent variable for MT. In order to test the hypothesis, the researcher examined each primary dependent variable (Y1, Y2, Y3) with discriminant function analysis using a subprogram from SPSS.

Table 23 shows classification results for the rating on Y1 by each category and level of rater. Fewer than one third of the cases approximated the true category of the respondent. The roles of the independent and dependent variables were reversed in this procedure (see Chapter III). Category of rater was incorrectly predicted for MT. The values for prediction of groups based on MLT rating are provided in Table 24, which shows that only one third of the cases were accurately grouped. Category could not be predicted from the rating of MLT (Y2).

The correct prediction of groups from the CLA rating was less than one half of the cases according to the classification results shown in Table 25. These data derived from the SPSS Discriminant program clearly indicated that category and/or level of rater could not be predicted from the overall ratings of MT, MLT, or CLA. Since few cases were accurately grouped, Hypothesis 10 was retained.

Hypothesis 11. Hypothesis 11 stated that no discrimination effect existed among categories of rater on the individual subject areas of the task analysis questionnaire for each level of personnel rated. Table 26 presents the values for Wilks' lambda and the analogous F ratio for each subject area for each level of personnel. The F ratios

TABLE 23
CLASSIFICATION RESULTS FOR MT(Y1) BY CATEGORY BASED ON DISCRIMINANT FUNCTION ANALYSIS

			Predicted Groups					
Actual Group	Group Name	N of Cases	11	12	13	21	22	32
11	MT Educators	16	13* (81%)†	3 (19%)				
12	MLT Educators	10	6 (60%)	2* (20%)		2 (20%)		
13	CLA Educators	1			1* (100%)			
21	MT Chief Techs	18	4 (22%)	6 (33%)	1 (6%)	7* (39%)		
22	MLT Chief Techs	3	2 (67%)			1 (33%)	*	
32	MLT Graduates	36	14 (39%)	7 (19%)	2 (6%)	11 (30%)	1 (3%)	1* (3%)

PERCENTAGE OF "GROUPED" CASES CORRECTLY CLASSIFIED: 28.57%

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*indicates correct group
†percentages were rounded off

TABLE 24
CLASSIFICATION RESULTS FOR MLT(Y2) BY CATEGORY BASED ON DISCRIMINANT FUNCTION ANALYSIS

Actual Group	Group Name	N of Cases	Predicted Groups					
			11	12	13	21	22	32
11	MT Educators	14	5* (36%)†	4 (29%)		2 (14%)	1 (7%)	2 (14%)
12	MLT Educators	10	5 (50%)	*	1 (10%)	2 (20%)		2 (20%)
13	CLA Educators	1			1* (100%)			
21	MT Chief Techs	19	4 (21%)	1 (5%)	4 (21%)	5* (27%)	4 (21%)	1 (5%)
22	MLT Chief Techs	3				1 (33%)	2* (67%)	
32	MLT Graduates	46	7 (15%)	6 (13%)	5 (11%)	7 (15%)	2 (4%)	19* (42%)

PERCENTAGE OF "GROUPED" CASES CORRECTLY CLASSIFIED: 34.41%

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*indicates correct group

†percentages were rounded off

TABLE 25
CLASSIFICATION RESULTS FOR CLA(Y3) BY CATEGORY BASED ON DISCRIMINANT FUNCTION ANALYSIS

Actual Group	Group Name	N of Cases	Predicted Groups					
			11	12	13	21	22	32
11	MT Educators	14	9* (65%)†			1 (7%)	2 (14%)	2 (14%)
12	MLT Educators	10	3 (30%)	1* (10%)	2 (20%)		2 (20%)	2 (20%)
13	CLA Educators	1			1* (100%)			
21	MT Chief Techs	18	2 (11%)	1 (6%)	3 (17%)	4* (22%)	3 (17%)	5 (27%)
22	MLT Chief Techs	3	1 (33%)		1 (33%)		1* (33%)	
32	MLT Graduates	37	9 (25%)	2 (5%)	2 (5%)	6 (16%)	2 (5%)	16* (43%)

PERCENTAGE OF "GROUPED" CASES CORRECTLY CLASSIFIED: 38.55%

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*indicates correct group

†percentages were rounded off

were essentially non-significant across subject areas among the three levels of personnel. The hematology area for MLT and CLA as well as the urinalysis area for CLA was significantly different from other areas. The values for Wilks' lambda were high for each of the subject areas indicating little discrimination among subject areas. The value of $1 - \Lambda$ relates to the proportion of variance contributed by each subject area. These values are easily calculated from the data of Table 26. The calculations show small amounts of variance among subject areas. Kerlinger and Pedhazur (1973) indicated that Wilks' lambda could be used to calculate a formula for F. The conversion is equivalent and the value for Wilks' lambda may be used to provide this exact F ratio. The formula which Kerlinger and Pedhazur advocated was used in the SPSS Discriminant procedure to calculate the F statistic. The data showed that no discrimination effect occurred. The generation of discriminant functions also failed to separate the groups. Based on data from the discriminant function analysis, Hypothesis 11 was retained.

Hypothesis 12. For the testing of Hypothesis 12, the scores on Y1, the primary dependent variable for MT; Y2, the primary dependent variable for MLT; and Y3, the primary dependent variable for CLA, were subjected to discriminant function analysis to determine if the categories of raters could be predicted from the mean scores on the three levels rated. The source of variance was category of rater. Significant F values were generated for Y1 and Y3, but not for Y2. The two functions discriminated between categories for separate ratings of Y1, Y2, and Y3 (see Table 27). The classification results in Table 27 showed that half of the cases were grouped correctly.

TABLE 26
WILKS' LAMBDA(Λ) AND UNIVARIATE *F* RATIOS FOR MT, MLT, AND CLA FROM DISCRIMINANT FUNCTION ANALYSIS (df=5,78)

	Variable and Descriptor		Wilks' Lambda (Λ)	*F*
MT RATING	Y01	Overall MT	.89979	1.74
	Y04	Urinalysis	.92416	1.28
	Y05	Blood Bank	.94494	.91
	Y06	Serology	.90564	1.63
	Y07	Chemistry	.92905	1.19
	Y08	Microbiology	.89329	1.86
	Y09	Hematology	.87580	2.23*
MLT RATING	Y02	Overall MLT	.90130	1.91
	Y10	Urinalysis	.89371	2.07
	Y11	Blood Bank	.90914	1.74
	Y12	Serology	.94009	1.10
	Y13	Chemistry	.90906	1.71
	Y14	Microbiology	.89846	1.97
	Y15	Hematology	.89745	1.99
CLA RATING	Y03	Overall CLA	.87625	2.17
	Y16	Urinalysis	.84380	2.85*
	Y17	Blood Bank	.91924	1.35
	Y18	Serology	.89088	1.89
	Y19	Chemistry	.90960	1.53
	Y20	Microbiology	.90022	1.71
	Y21	Hematology	.86011	2.05*

*$p<.05$

TABLE 27
DISCRIMINANT FUNCTION DATA AFTER MANOVA
FOR MT, MLT, AND CLA

Source of Variance	Variable	Λ	F	Function 1	Function 2
Category of Rater	Y1	.7742	5.32*	1.441	.6238
	Y2	.8857	2.35	-1.821	.3097
	Y3	.8732	9.14	- .549	.4588

$p<.05$

TABLE 28
CLASSIFICATION RESULTS OF DISCRIMINANT
FUNCTION ANALYSIS ON Y1, Y2, Y3

Actual Group	N	Predicted Group				
		1	2	3	4	5
1. MT Educators	14 (77%)	10* (8%)	2 (15%)			
2. MLT Educators	10	4 (40%)	1* (10%)	2 (20%)	1 (10%)	
3. MT Chiefs	19	2 (12%)	3 (18%)	3* (41%)	4 (24%)	1 (5%)
4. MLT Chiefs	3				3* (100%)	
5. Graduates	36	8 (23%)	3 (9%)	6 (19%)		18* (51%)

*correct group

When analyzed separately, the group of MT educators was correctly classified, but MLT educators and chief technologists could not be correctly predicted. Just over 50% of the MLT graduates were correctly grouped. The correct prediction of groups was not possible from data of the classification results. The researcher noted, however, that at least one category, MT, was correctly grouped. The correct prediction of only 20% of the raters was not significant. Thus, Hypothesis 12 was retained.

Hypothesis 13. Hypothesis 13 concerned the relationship among all three ratings for all groups of raters. This hypothesis was the first to be tested with multivariate analysis of variance. The researcher attempted to determine simultaneous homogeneity of group means for Y1, Y2, and Y3. Results of the MANOVA procedure are provided in Table 29. From these data, the conclusion was drawn that variation by category of rater existed for Y1 and Y2, but not for Y3. Variation by level was present only for Y3. The interaction was not significant. The means for each rating by category were presented in Table 10, which may be a helpful reference for interpreting the MANOVA statistics.

When Y1, Y2, and Y3 were considered simultaneously, the partial correlation coefficients (analogous to the β statistics of regression and discriminant function) provided data to support the consideration of homogeneity of means. These coefficients are presented in Table 30. The production of coefficients is a technique of control in which two variables are considered together while a third is controlled (Kerlinger and Pedhazur, 1973). The correlation of Y1 and Y2 was .8892, but the correlation of .4806 between Y1 and Y3 indicated heterogeneity

TABLE 29
SIGNIFICANT STATISTICS FROM MANOVA FOR MT(Y1), MLT(Y2), AND CLA(Y3)

Source of Variation	Y1		Y2		Y3	
	df	F	df	F	df	F
Category	2	9.96*	2	3.69*	2	2.59*
Level	1	.15	1	.83	1	4.59*
Interaction	1	.17	1	.82	1	.10

*$p < .05$

TABLE 30
PARTIAL CORRELATION COEFFICIENTS FROM MANOVA FOR Y1, Y2, Y3

df=71	Y1	Y2	Y3
Y1	1.0000	.8892	.4806
Y2	.8892	1.0000	.6035
Y3	.4806	.6035	1.0000

of means. The heterogeneity was confirmed with the characteristic roots and vectors in Table 31 and the test criteria for MANOVA in Table 32. As suggested by Olson (1976), Cooley and Lohnes (1971), and R.J. Harris (1975), the best test statistic for MANOVA is the Pillai Trace. The Wilks' lambda statistic, also provided by the SAS program MANOVA, is however, more popular and more easily understood (Kerlinger and Pedhazur, 1973; Olson, 1976). The Pillai Trace calculated by the formula, V=[H*INV(H+E)], was significant as indicated by its analogous F ratio.

Data from the multivariate analysis provided a basis for observing significant differences among the means of the three levels (Y1=3.76; Y2=3.29; Y3=2.59). According to the partial correlation coefficients, differences were probable between Y1 and Y3, and, to a lesser extent, between Y2 and Y3. Thus, Hypothesis 13 was rejected.

Hypothesis 14. The premise of Hypothesis 14 was that no significant difference exists in the perception of competence of all three levels of personnel by chief technologists. From the MANOVA procedure, data were obtained indicating poor correlation between Y1 and Y3 for all categories and between Y2 and Y3 for all categories. These data showed that Y1, Y2, and Y3 were not homogeneous across groups. The MANOVA data, did not, however, separate categories.

In order to compare all three levels for one category, chief technologists, a scattergram was printed by an SPSS subprogram. The graph was a two-dimensional plot of two Y values. The statistics included simple regression. The Pearson product-moment correlation

TABLE 31
CHARACTERISTIC ROOTS AND VECTORS
FOR CATEGORY FROM MANOVA

Characteristic Root	Percentage	Characteristic Vector		
		Y1	Y2	Y3
.4484	83.63	-.3742	.2819	.0975
.9878	16.37	-.1221	.3640	-.1173
.0000	0.00	.1916	-.2007	.2056

TABLE 32
MANOVA TEST CRITERIA FOR THE EFFECT
OF CATEGORY ON Y1, Y2, and Y3

Test	Value	F analog
Hotelling-Lawly Trace	TR=.53624	*F* (6,138) = 6.17*
Pillai-Bartlett Trace	V=.39031	*F* (6,142) = 5.74*
Wilks' Lambda	Λ=.63471	*F* (6,140) = 5.96*

*$p<.05$

coefficients and tests of significance were provided. These statistics of bivariate correlation, although less complicated than multivariate techniques, provided a clearer presentation of relationships between two variables.

The Pearson product-moment correlation coefficient, symbolized by _r_, served as the measure of goodness of fit of the linear regression. Besides being a measure of goodness of fit, the Pearson _r_ indicated the strength of the linear relationship between the two variables. The Pearson _r_, when squared, became a measure of the proportion of variance in one variable "explained" by the other.

From the scattergram data, the bivariate correlation of Y1 with Y2 for chief technologists indicated a strong relationship between the means for MT and MLT. The regression line produced a slope (β) of .52913. The r^2 value showed that almost 58% of the variance in one of the dependent measures, Y1 or Y2, was "explained" by the other variable (Y1 or Y2). These data indicated little difference in the rating of MT and MLT by chief technologists (see Table 33).

The linear relationship of Y1 with Y3 was less strong. The r^2 value showed that only 22% of the variance of Y1 was "explained" by Y3. The scattergram did not produce a clear regression line.

The relationship of Y2 to Y3 showed a Pearson's _r_ that was slightly more positive than the relationship between Y1 and Y3. The r^2 value indicated that 29% of the variance of Y2 (or Y3) was "explained" by Y3(orY2). A clear linear graph was not produced.

The strongest relationship was shown between Y1 and Y2 indicating homongeneity of means. Chief technologists rated MTs and MLTs essentially the same. A slightly positive relationship was shown between Y2 and Y3, indicating some homogeneity between MLTs and CLAs.

The least significant relationship was shown between Y1 and Y3 showing less homogeneity for MT and CLA. The resultant data from the bivariate correlation and scatterplot of means for chief technologists provided a basis from which Hypothesis 14 was rejected.

TABLE 33
BIVARIATE CORRELATION COEFFICIENTS OF
Y1, Y2, Y3 FOR CHIEF TECHS

	Pearson's *r*		
Variables	Chiefs	Educators	Graduates
Y1 and Y2	.76142	.43746	.89334
Y1 and Y3	.46131	.11923	.49631
Y2 and Y3	.54016	.55733	.59130

Hypothesis 15. Hypothesis 15 concerned perceptions of homogeneity of means by educators. The bivariate relationship between two sets of means was expressed by using the scatterplot and Pearson's *r*, discussed in relationship to Hypothesis 14. The relationship between MTs and MLTs, for educators, failed to show a linear slope. The correlation coefficient between Y1 and Y2 (see Table 33) resulted in only 19% of the variance of one variable "explaining" the other. The relationship between MTs and CLAs was less distinct and showed a weak relationship or heterogeneity of means. One of the variables accounted for less than 2% of the variance of the other. The relationship between MLTs and CLAs was stronger. The proportion of

variance expressed as $\underline{r}^2$ of one variable on the other was 31%. From these data, heterogeneity of means was confirmed for educators. The greatest disparity was seen between MTs and CLAs and the most positive correlation was between MLTs and CLAs. Hypothesis 15 was rejected.

Hypothesis 16. Hypothesis 16, which concerned perceptions of heterogeneity of means by graduates was also examined using measures of bivariate correlation and simple linear regression. The graduates' perception of the homogeneity between MTs and MLTs was confirmed with a high value for $\underline{r}$ and an $\underline{r}^2$ of .65. The homogeneity between MTs and CLAs was not as strong since the proportion of variance of one variable "explained" by the other was only 25%. The relationship between MLTs and CLAs was slightly positive and the $\underline{r}^2$ was .35. The regression line was linear between MTs and MLTs and the data points of the graph indicated a systematic relationship between Y1 and Y2. The relationship was less clear between Y1 and Y3 and Y2 and Y3. From the data of bivariate correlation and regression, Hypothesis 16 was rejected. Homogeneity of means was apparent for MTs and MLTs but heterogeneity between MTs and CLAs was probable. Thus, Hypothesis 16 was rejected.

Hypothesis 17. Hypothesis 17 concerned the impact of MLTs on hospital staffing patterns. Data were collected from all chief technologists who responded to the original questionnaire and from selected MT educators who were employed by hospitals. Conclusions based on the data in Table 34 were that all levels of registered personnel had increased over the last decade and numbers of non-registered personnel had decreased. The greatest increase in registered personnel was seen in the MLT level. MLTs constituted only 17% of the total laboratory staff in 1980 while MTs constituted more than 60%. Since MLTs were fewer than one percent of the laboratory staff in 1970, the increase to 17% in 1980 was significant. For all sizes of hospitals the number of MLTs had, however, increased almost 15 times the number employed in those hospitals in 1970. Due to the findings on employment, Hypothesis 17 was rejected.

Summary. The testing of 17 hypotheses resulted in the retention of eight hypotheses and the rejection of nine. Those which were rejected produced the most meaningful data for the study. Statistical methods used to test the hypotheses included factorial ANOVA, ONEWAY ANOVA, MANOVA, Discriminant Function, Frequencies, Correlation, and Scattergrams. The two most significant hypotheses, 13 and 17, were rejected on the basis of statistical data from multivariate analysis and percent change during a ten-year period. A summary of each hypothesis follows:

H01.	No significant difference exists among the perceptions by educators, chief technologists, and MLT graduates, of the competence of MTs with one year of experience.	(Retained)
H02.	No significant difference exists among the perceptions by educators, chief technologists, and MLT graduates, of the competence of MLTs with one year of experience.	(Rejected)
H03.	No significant difference exists among the perceptions by educators, chief technologists, and MLT graduates, of the competence of CLAs with one year of experience.	(Rejected)
H04.	Educators' perceptions of MT competence on blood bank tasks are significantly higher than those of chief technologists or MLT graduates.	(Rejected)

H05. Chief technologists' perceptions of MLT competence on blood bank ratings are significantly lower than the perceptions by educators or graduates. (Retained)

H06. Perceptions of CLA competence on blood bank ratings are not significantly different among chief technologists, educators, or graduates. (Retained)

H07. No significant difference exists among the perceptions by educators, chief technologists, and MLT graduates, of the competence of MTs on serology tasks. (Retained)

H08. MLT graduates' perceptions of MLT competence on serology tasks are significantly lower than the perceptions by chief technologists. (Rejected)

H09. No significant difference exists among the perceptions by educators, chief technologists, or MLT graduates, of the competence of CLAs on serology tasks. (Retained)

H10. Category of rater (educator, chief technologist, MLT graduate) cannot be predicted from individual ratings of MT, MLT, or CLA by all raters. (Retained)

H11. No significant discrimination effect exists among categories of rater on individual subject areas of MT, MLT, and CLA ratings. (Retained)

H12. Category of rater cannot be predicted from the combined ratings of MT, MLT, and CLA by all raters. (Retained)

H13. No significant difference exists in the perceptions by all raters of competence of MTs, MLTs, and CLAs with one year of experience. (Rejected)

H14. No significant difference exists in the perceptions by chief technologists of the competence of MTs, MLTs, and CLAs with one year of experience. (Rejected)

H15. No significant difference exists in the perceptions by educators of the competence of MTs, MLTs, and CLAs with one year of experience. (Rejected)

H16. No significant difference exists in the perceptions by MLT graduates of the competence of MTs, MLTs, and CLAs with one year of experience. (Rejected)

H17. The emergence of the MLT has had no significant effect on traditional staffing patterns in North Carolina hospital laboratories. (Rejected)

Implications and conclusions of the differences among raters and levels rated, as well as staffing pattern changes, are presented in Chapter V which contains recommendations.

TABLE 34

TRANSITION OF NORTH CAROLINA HOSPITAL LABORATORY STAFFING PATTERNS FROM 1970 TO 1980 AS SHOWN BY MEAN NUMBERS OF EACH LEVEL OF PERSONNEL EMPLOYED

Level of Personnel	Size of Hospital	1970 $\bar{X}$	1980 $\bar{X}$	Percent Change
MT(ASCP)	A	1	4	
	B	3	8	
	C	12	23	
	D	12	23	
	For all sizes	7	15	+53
MLT(ASCP)	A	0	3	
	B	0	4	
	C	1	4	
	D	0	4	
	For all sizes	.25	3.75	+93
CLA(ASCP)	A	2	2	
	B	2	2	
	C	1	1	
	D	5	6	
	For all sizes	2.5	2.75	+ 9
Non-registered personnel	A	3	4	
	B	5	4	
	C	3	1	
	D	3	4	
	For all sizes	3.5	3.25	- 8
All personnel	A	6	13	
	B	10	18	
	C	17	29	
	D	20	37	
	For all sizes	13.25	24.25	+55

```
                     Size A Hospital

   1970                                      1980

     *                                         *
                                             # # #

   0   0                                     0   0
   ↓ ↓ ↓                                   ↓ ↓  ↓ ↓
----------------------------------------------------------
                     Size B Hospital

     *                                         *
    * *                                       * *
                                           * * * * *

                                            # # # #

   0   0                                      0  0
 ↓  ↓ ↓ ↓ ↓                                 ↓ ↓ ↓ ↓
----------------------------------------------------------
                     Size C Hospital

     *                                         *
    * *                                      *****
   ** **                                    *******
   ** **                                   *********

     #                                      # # # #

     0                                         0
   ↓ ↓ ↓                                       ↓
----------------------------------------------------------
                     Size D Hospital

     *                                        * *
   *****                                     *****
  *******                                   *******
                                           *********
                                            # # # #

 0 0 0 0 0                                 000 0 0 0
   ↓ ↓ ↓                                    ↓ ↓ ↓ ↓
----------------------------------------------------------
```

* MT(ASCP)
# MLT(ASCP)
0 CLA(ASCP)
↓ non registered personnel

Figure 2
Change in hospital staffing patterns

CHAPTER V
SUMMARY, CONCLUSIONS, AND IMPLICATIONS

The purposes of this study were to identify: (1) tasks performed by three levels of laboratorians, (2) commonalities and differences in competence for the three levels of laboratorians, (3) characteristics of MLT graduates, and (4) the impact of MLT graduates on laboratory staffing patterns in North Carolina hospitals. The need for studying staffing patterns arose as a result of the introduction into the modern hospital laboratory of the newest level, the associate degree medical laboratory technician. Little research on the effectiveness of or the need for the middle level (MLT) laboratorian had been published since the first administration of the MLT Registry examination of ASCP in 1970. The dearth of research available on the MLT level of laboratory personnel stimulated the interest in this research.

A total of 100 persons responded to the survey which was concerned with the perceptions of competence of each level of laboratorian. These respondents, representing 65% of those surveyed, were selected by stratified random sampling (the chief technologist group), cluster sampling (the MLT graduates), and systematic sampling (the educators). The three populations from which the respondents were sampled included chief technologists from 145 general, acute care hospitals in North Carolina, six classes of graduates from one MLT program, and educators from 25 laboratory programs in North Carolina.

The final group of respondents from whom data were collected included 24 chief technologists, 27 educators, and 49 MLT graduates.

The test instrument for the study was a task analysis questionnaire developed by the researcher. It contained 270 medical laboratory tasks that were validated by expert consensus and tested for statistical reliability. Respondents were expected to rate each of three levels of laboratorian (MT, MLT, CLA) on each of the 270 tasks using a four-point Likert-type scale.

The design of the study was a hypothesis-testing, ex post facto, field study which had for its model a 3 x 2 factorial structure with unbalanced cells. Three primary dependent variables (mean scores on all tasks) were MT rating, MLT rating, and CLA rating. The two independent variables were category, which had three levels, and level of training, which had two levels.

Because the factorial design using attribute independent variables and continuous, integer-level dependent variables was complicated and had uneven cells, several different statistical procedures were employed. The impact of the three categories and two levels of personnel on laboratory medicine, as measured by variations in perception of competence, was examined by testing 17 hypotheses.

Data from the questionnaires were coded onto forms and keypunched on computer cards for statistical analysis by computer software packages from the Statistical Package for the Social Sciences (Nie et al., 1975; Hull and Nie, 1979) and the Statistical Analysis System (Barr et al., 1979).

Since the hypotheses were extensive, they are restated here with a summary of the findings pertinent to each.

> Hypothesis 1. No significant difference exists among the perceptions by educators, chief technologists, and graduates of the competence of MTs with one year of experience.

This hypothesis was not rejected. The MT level was subjected to a two-way ANOVA which did not show significant differences in main effects for MTs at the .05 level of significance. Homogeneity of means was confirmed. Hypothesis 1 was retained.

> Hypothesis 2. No significant difference exists in the perceptions by educators, chief technologists, and graduates of competence of MLTs with one year of experience.

Hypothesis 2 was rejected on the basis of significant ($p<.05$) differences in main effects of category for the two-way ANOVA. Results were confirmed with a multiple classification analysis and a posteriori tests of simple main effects. According to Duncan's Multiple Range Test, chief technologists' ratings of MLT competence were significantly different from ratings by either educators or graduates. Chief technologists rated MLTs lower than the other groups did.

> Hypothesis 3. No significant difference exists in the perceptions by educators, chief technologists, and graduates of competence of CLAs with one year of experience.

This hypothesis was rejected on the basis of data obtained from the two-way ANOVA, ONEWAY ANOVA, and Duncan's Multiple Range Test. Chief technologists maintained significantly lower perceptions of CLA competence from those held by educators or MLT graduates.

> Hypothesis 4. Educators' perceptions of MT competence on blood bank ratings are significantly higher than those of chief technologists or MLT graduates.

This hypothesis was rejected primarily on the basis of data obtained from the two-way ANOVA and multiple classification analysis of blood bank tasks. Homogeneity of group means was observed with no group providing higher ratings than the other two groups.

> Hypothesis 5. Chief technologists' perceptions of MLT competence on blood bank ratings are significantly lower than the perceptions by educators or graduates.

This hypothesis was retained since heterogeneity of group means was supported by data from a two-way ANOVA, ONEWAY ANOVA, and a posteriori tests of group means. The chief technologists were separated from the other two groups by Tukey's test of Honestly Significant Difference (of means). The lower mean for chief technologists was significant at the $p<.05$ level, and Hypothesis 5 was retained.

> Hypothesis 6. Perceptions of CLA competence on blood bank ratings are not significantly different among chief technologists, educators, or graduates.

Heterogeneity of variance could not be supported by data from the ANOVAs. Significant F ratios were inconsistent among procedures, and Hypothesis 6 was retained.

> Hypothesis 7. No significant difference exists among the perceptions by educators, chief technologists, and MLT graduates, of the competence of MTs on serology tasks.

Significant differences in serology ratings for the MT level were not confirmed from the two-way ANOVA. The deviation scores from the multiple classification analysis failed to separate the groups, confirming homogeneity of variance. Thus, Hypothesis 7 was retained.

> Hypothesis 8. MLT graduates' perceptions of MLT competence on serology tasks are significantly lower than the perceptions by chief technologists.

The two-way ANOVA failed to indicate differences between the two groups. Data from the tables of frequency distributions indicated that the graduates (MLT) rated themselves almost 20% higher than the chief technologists rated them. For this reason, Hypothesis 8 was rejected.

> Hypothesis 9. No significant difference exists among the perceptions by educators, chief technologists, or MLT graduates, of the competence of CLAs on serology tasks.

No significant separation of levels of category could be confirmed. Data from the a posteriori tests following the ONEWAY ANOVA were conflicting and no support for heterogeneity of group means was obtained. Hypothesis 9 was retained.

> Hypothesis 10. Category of rater (educator, chief technologist, MLT graduate) cannot be predicted from individual ratings of MT, MLT, or CLA by all raters.

The correct prediction of category from MT, MLT, and CLA group means approximated 33%. On the basis of data from the discriminant function analysis, Hypothesis 10 was retained.

> Hypothesis 11. No significant discrimination effect exists among categories of rater on individual subject areas of MT, MLT, and CLA ratings.

Data were obtained from discriminant function analysis. Only two areas were separate: hematology and urinalysis. The generation of discriminant functions failed to separate the groups. Hypothesis 11 was retained.

> Hypothesis 12. Category of rater cannot be predicted from the combined ratings of MT, MLT, and CLA by all raters.

Discriminant functions were derived and classification results provided correct groups in only 50% of the cases. When analyzed separately, MT educators were correctly grouped, but other groups were not correctly grouped. Since only 20% of all the groups were correctly predicted, or classified, Hypothesis 12 was retained.

> Hypothesis 13. No significant difference exists in the perceptions by all raters of competence of MTs, MLTs, and CLAs with one year of experience.

Using data obtained from multivariate analysis, the researcher noted significant differences among means. These differences were supported by the partial correlation coefficients obtained from the MANOVA procedure. Differences were indicated between MTs and CLAs, and Hypothesis 13 was rejected.

> Hypothesis 14. No significant difference exists in the perceptions by chief technologists of the competence of MTs, MLTs, and CLAs with one year of experience.

Although differences among levels of personnel were observed in the testing of Hypothesis 13 with multivariate analysis, the source of variance within one category could not be determined. The testing of Hypothesis 14 showed differences among means for one category, chief technologists. Those differences were demonstrated using bivariate correlations of MTs and MLTs, MTs and CLAs, and MLTs and CLAs. Pearson product-moment correlations, simple linear regression, and scatterplots provided data to support the heterogeneity of means as perceived by chief technologists. Hypothesis 14 was rejected.

> Hypothesis 15. No significant difference exists in the perceptions by educators of the competence of MTs, MLTs, and CLAs with one year of experience.

Data obtained from bivariate correlations, scatterplots, and simple linear regression showed little relationship between MTs and CLAs, but the relationship between MLTs and CLAs was strongly positive. Hypothesis 15 was rejected.

> Hypothesis 16. No significant difference exists in the perceptions by MLT graduates of the competence of MTs, MLTs, and CLAs with one year of experience.

Using data obtained from bivariate correlation analysis, homogeneity of means was apparent for MTs and MLTs, but heterogeneity of means of MLTs and CLAs and of MTs and CLAs was found. Hypothesis 16 was rejected.

> Hypothesis 17. The emergence of the MLT has had no significant effect on traditional staffing patterns in North Carolina hospital laboratories.

Data were obtained from chief technologists and educators employed in randomly selected hospitals across the state. The number of laboratorians registered by ASCP had increased at all levels during the last decade, but the greatest increase was in the number of MLTs. For all sizes of hospitals, the number of MLTs had increased to almost 15 times the number employed in 1970. From the information obtained from chief technologists, Hypothesis 17 was rejected.

Conclusions

General conclusions from the data were that (1) differences in competence among three levels of laboratory workers were observed, (2) differences in perception of the competence of one level of personnel were observed across categories of raters, and (3) the MLT level has played a significant role in these differences and also in staffing pattern changes of hospital laboratories.

Particular conclusions were that (1) chief technologists had different perceptions of MLT and CLA competence than those held by educators and MLT graduates; (2) the MT was rated equally on blood bank by all raters; (3) the MLT was perceived by chief technologists to be less competent in blood banking than by educators or MLT graduates; (4) the CLA was rated low in blood banking by all categories of raters; (5) MLT graduates rated the MLTs 20% higher on serology tasks than the chief technologists rated them; (6) ratings on individual subject areas could not predict category of rater; (7) MTs, MLTs, and CLAs were not rated equally by all raters as a group, and significant differences were observed between the competence of MTs and CLAs; (8) chief technologists perceived differences in competence among MTs, MLTs, and CLAs; (9) educators perceived differences in competence among MTs, MLTs, and CLAs; (10) MLT graduates perceived homogeneity of competence between themselves and MTs and heterogeneity between MTs and CLAs; (11) the 15-fold increase in a ten-year period in numbers of MLTs employed in hospital laboratories was significant, and their increase was primarily due to the creation of new positions rather than to the decrease of non-certified personnel.

Biographical Data

Biographical data submitted by respondents indicated that most educators and chief technologists were employed when the MLT graduate emerged on the scene of laboratory medicine in the early 1970s. These educators and employers have observed the transition in types of manpower during the last decade. Likewise, they have observed the changing field of clinical laboratory sciences from the time when cumbersome manual procedures were the rule, to the day when sophisticated, automated performance of tasks accompanies diagnostic procedures. More than 80% of the respondents, excluding the MLT graduates, were certified as MT(ASCP). More than 50% of those had more than 10 years of experience. A little more than half of the chief technologists were involved in didactic or "bench" teaching in various hospitals or colleges. The majority (80%) of respondents appeared to have current knowledge of performance of the 270 tasks as attested by their attendance of continuing laboratory education meetings. The similarities of certification, experience, expertise, and current knowledge between and within groups of educators and chief technologists did not preclude variations in perceptions of competence. Differences were observed between and among levels and categories.

The MLT graduates were currently working in, and for the most part, currently enjoying laboratory medicine. Almost half worked in hospitals of more than 200 beds. While their mean years of experience were few, some graduates had attained positions as section chiefs, clinical instructors, shift supervisors, and managers. Ten percent had perceived the need for career mobility by achieving bachelor's degrees in medical technology. More than 80% expressed their confidence as MLTs, but 63% felt that, for their knowledge and skills, they largely go unrewarded.

Implications for Research

Certain conclusions and implications may be drawn from this study. As stated earlier, the primary purpose of the study was to identify commonalities and differences among levels of laboratory workers with consideration of the impact of the MLT level on performance of tasks and on changes in staffing patterns. Sufficient data were obtained from the respondents to provide the conclusions discussed above for each hypothesis and for subjective responses of personal data.

Guidelines for the performance of laboratory responsibilities have been addressed by others during the past decade (ASMT, 1980; Bailey, 1973; Hedrick and Fiene, 1974; Reeder et al., 1974). The most significant of these appears to be the ASMT project which has been underway since the early 1970s and is still unfinished. The ASMT Position Paper (1973) first addressed these differences in competence after several MLT programs were established. This study has been an attempt to present data to support ASMT's idea of delineation of roles and to support commonalities and differences among levels of practitioners. ASMT (1980) has provided a statement concerning the scope of practice, the body of knowledge, and statements of competence during the last several years. The Body of Knowledge, presented in June, 1980, at the ASMT Annual Meeting, provided a content outline for the cognitive skills of laboratory practice. During the next decade the specific competencies should be delineated for the several levels of laboratory personnel.

Previous studies have indicated no significant differences for the three levels of medical laboratory personnel. The present study has not confirmed those results. The studies reviewed in Chapter II showed no differences in performance of tasks among levels. Bailey's (1973) study indicated that

> regardless of the educational background of the worker, the same percentage of workers in each category performed the same tasks. (p. 136)

The most significant conclusion for the failure of this study to affirm those results was that fewer MLT programs existed in the early 1970s. Bailey concluded that the same number of CLAs and MTs performed the same tasks. The present study presented data to show differences in competence between CLAs and MTs. The present study was, to some extent, built on Bailey's research. As a result of the present findings, additional research should be conducted by those interested in seeking other answers to the questions of competence among levels. Data from the present study formed the bases for implying that differences in degree of competence, as rated on a Likert-type scale, were observed among levels of laboratory workers. Some categories of raters perceived the MT and MLT to possess a similar degree of competence. The MT and CLA appeared to have different degrees of competence.

The MLT appears to occupy an important position in the hierarchy of clinical laboratory sciences. MLTs are sure to remain important in laboratory medicine for the foreseeable future. Some MLTs will desire, however, to obtain higher professional credentials.

Data from this study allowed the researcher to refute the findings of the West Virginia study by Reynolds and others (1976) who showed that registered and non-registered personnel performed the same routine tasks. While non-registered personnel were not included in the present study, significant differences were observed among levels of registered personnel. Hence, the implication was drawn that greater differences would be observed between registered and non-registered personnel. The study by Reynolds and others concerned only the routine performance of tasks. The present study also included degrees of competence in performing those tasks, which may have accounted for the different findings.

Cohen and Korper (1977) indicated that level of personnel was not important in job status. They observed no differences in job status and level of education. The small sample of MLTs may have limited the usefulness of those data. The MLTs and CLAs were grouped together in the study, and no differences could be determined between them. Biographical data from the present study show that educational levels are different and that job status or position varies for MLTs and chief technologists.

Miller (1979) indicated that MLTs perform 90% to 95% of the routine tasks and that greater cost effectiveness could be obtained by employing them. He indicated, however, that the MLT should learn only the routine tasks. Some data in the present study may have shown that MLTs and MTs have similar degrees of competence which implies that the MLT is quite capable of learning more than the routine procedures.

Those who have addressed the future of allied health (National Commission, 1980) have indicated that the technician level is greatly needed and will continue to thrive. Data from the present study support the National Commission's findings for the MLT level and the impact on the staffing patterns of hospitals. An implication from the present research, in light of other predictions is that the MLT will continue to exist while the CLA may become passé.

Indications from various certifying groups, including ASCP and NCA, and from those who predict trends in allied health (National Commission, 1980) are that after 1982 the CLA level will have begun phasing out, especially in terms of formal education programs (American Medical Association, 1980).

What suggestions for further research are appropriate in light of these findings? Several suggestions are currently being publicized by ASMT (1980) and by other professional groups (National Commission, 1980).

These include the need for specific delineation of roles, scope of practice, cognitive and affective skills, and the need for specifying statements of competence for levels ("Statements," 1976). The Competence Assurance project of ASMT is a potential solution. The Body of Knowledge is one phase of the Competence Assurance project.

This study has addressed some concerns of laboratory professionals. Specific recommendations and suggestions include the following:

(1) The CLA level should be phased out and efforts should concentrate on competence assurance for the MLT and MT levels.

(2) Job performance descriptions for MT and MLT should be written and should serve as standards to be used by the profession.

(3) Educators should assess degrees of competence with the use of written examinations for both levels to be given either at career entry or one year later for the purpose of delineation of differences. The certification examinations should not be used for this purpose.

(4) Educators should compare perceptions of competence among the levels by using other groups of raters including MT and CLA graduates.

(5) The present study should be replicated using the biographical data as moderating variables or covariates.

(6) Educators should attempt to prevent proliferation of laboratory programs and should concentrate their efforts on improving the quality of existing programs. One approach would be to determine appropriate content for various levels of programs.

(7) Educators should continue to facilitate transition from MLT to MT level with articulation agreements between community colleges and universities, recognizing the knowledge and skills held by MLTs.

While largely a statistical treatise, this study has attempted to provide additional knowledge concerning competence among levels of laboratory personnel. Perhaps it will inspire other laboratorians to pursue similar studies of competence. The statistical conclusions indicate that differences do occur between and among levels of personnel and between and among levels of raters. Perhaps with clearer delineation of roles of medical laboratory personnel by ASMT and other groups will come greater knowledge of the true competence possessed by each level of personnel.

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APPENDIX A

ORIGINAL COVER LETTER FOR QUESTIONNAIRE

Sandhills Community College

ROUTE 3, BOX 182-C
CARTHAGE, NORTH CAROLINA 28327
PHONE 919-692-6185

April 23, 1980

Dear Colleague:

The Department of Community Colleges is conducting a project to evaluate and update Medical Laboratory Technology programs in the system. One step in this project is that of identifying the tasks and level of competency needed for one to perform satisfactorily as a Medical Laboratory Technician. The enclosed is an inventory asking for your opinion about which competencies in laboratory medicine will be needed. Your opinion on this inventory will provide guidance for the evaluating and updating of the programs in our community college system.

You can assist Dr. Eller, Assistant Director of Health Programs for the state, and me in this project by completing the enclosed inventory in the stamped, addressed envelope. Your responses will be compiled with those of other individuals completing the inventory and no individual responses will be disclosed.

Please return the inventory by May 7,1980. Thank you very much for assisting in this project.

Sincerely,

Judith A. Davis, MT(ASCP)MEd.
MLT Project Director for the
NC Department of Community Colleges

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Enclosures

APPENDIX B

TASK ANALYSIS QUESTIONNAIRE

COMPETENCY BASED
MEDICAL LABORATORY TECHNOLOGY
CURRICULUM STUDY

This inventory concerns tasks which may be performed by technologists and technicians in clinical laboratory medicine. The following levels of personnel are included in this study: MT/CLS (Medical Technologist/Clinical Laboratory Scientist)--holds a baccalaureate degree in medical technology and is certified as MT by ASCP or CLS by NCAMLP; MLT/CLT (Medical Laboratory Technician/Clinical Laboratory Technician)--holds an associate degree in medical laboratory technology and is certified as MLT by ASCP or CLT by NCAMLP; CLA/CLT (Certified Laboratory Assistant)--has one year of formal laboratory training after high school and is certified as CLA by ASCP or CLT by NCAMLP.

The list of tasks in this study identifies skills which you would expect some or all of these persons to have attained after having worked for one year following training. The inventory may also include tasks which may not be performed by persons in clinical laboratory occupations. Please answer all questions/tasks included in this inventory. There are no correct or incorrect responses. The importance lies in your rating of the tasks or competencies. Please use the rating scale given below in making your evaluation of the degree of competence you possess for each task. For those levels which do not apply to you, indicate your feelings about the degree of competence of those levels of personnel for each task. If your feelings appear unrepresented, select the response which most closely resembles your feelings. Do not omit any items. Your responses will be tabulated with those of others and no individual responses will be disclosed. At the end of the list of tasks for each subject area, please add any additional items which you feel individuals need in clinical laboratory occupations, and rate each task that you add for each level of personnel.

Keep in mind that you should indicate what you do and what you think others do. The persons at levels other than yours have worked for one year following training.

Now, get a strong cup of coffee or tea and begin your analysis of the tasks. Thank you for your time and consideration of this important project.

Please circle the number of the rating (1 2 3 4) which you choose. For each item or task, the individual should possess:

1.NO competence--------requires instruction and supervision to complete the task.

2.MODERATE competence---completes the task satisfactorily with minimal assistance or supervision.

3.CONSIDERABLE competence--completes the task without supervision most of the time.

4.UTMOST competence--completes the task satisfactorily without any assistance or supervision.

Definition:

COMPETENCE: capacity to adequately carry out the total performance responsibilities of a laboratory worker.

TASK: a logically-related set of actions required for the completion of a job objective.

CLA	MLT	MT		URINALYSIS TASKS
1 2 3 4	1 2 3 4	1 2 3 4	1.	Examine urine specimens macroscopically for abnormal appearance.
1 2 3 4	1 2 3 4	1 2 3 4	2.	Perform chemical analysis of urine by utilizing dip and read (dipstix) test strips.
1 2 3 4	1 2 3 4	1 2 3 4	3.	Read and interpret dipstix reactions.
1 2 3 4	1 2 3 4	1 2 3 4	4.	Perform tests for non-glucose oxidase reducing substances.

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CLA	MLT	MT	
1 2 3 4	1 2 3 4	1 2 3 4	5. Confirm positive or questionable dipstix reactions with alternative chemical tests.
1 2 3 4	1 2 3 4	1 2 3 4	6. Recognize false positives and interfering substances on dipstix reactions.
1 2 3 4	1 2 3 4	1 2 3 4	7. Perform screening tests for salicylates utilizing Phenistix^{TM} or equivalent method.
1 2 3 4	1 2 3 4	1 2 3 4	8. Perform screening tests for ascorbic acid utilizing C-stix^{TM} or equivalent.
1 2 3 4	1 2 3 4	1 2 3 4	9. Perform semiquantitative tests for albumin in urine.
1 2 3 4	1 2 3 4	1 2 3 4	10. Perform a screening test for Bence Jones protein.
1 2 3 4	1 2 3 4	1 2 3 4	11. Perform a test for urinary urobilinogen other than dipstix.
1 2 3 4	1 2 3 4	1 2 3 4	12. Perform a test for myoglobin in urine.
1 2 3 4	1 2 3 4	1 2 3 4	13. Determine specific gravity of urine.
1 2 3 4	1 2 3 4	1 2 3 4	14. Determine specific gravity of urines which must be diluted in order to perform the test.
1 2 3 4	1 2 3 4	1 2 3 4	15. Determine osmolality of urine or serum.
1 2 3 4	1 2 3 4	1 2 3 4	16. Correlate specific gravity and osmolality results with urine glucose, sodium, and potassium values.
1 2 3 4	1 2 3 4	1 2 3 4	17. Perform microscopic examination of urine sediment correctly identifying normal and abnormal formed elements.
1 2 3 4	1 2 3 4	1 2 3 4	18. Perform microscopic examination of urine utilizing appropriate stains.
1 2 3 4	1 2 3 4	1 2 3 4	19. Examine urinary crystals with polarized light and/or phase microscopy.
1 2 3 4	1 2 3 4	1 2 3 4	20. Stain and examine urine sediments for lipids.
1 2 3 4	1 2 3 4	1 2 3 4	21. Examine synovial fluid for crystals, WBCs and RBCs.
1 2 3 4	1 2 3 4	1 2 3 4	22. Perform a mucin clot test on synovial fluid.
1 2 3 4	1 2 3 4	1 2 3 4	23. Establish and maintain an acceptable quality control program for urinalysis.
1 2 3 4	1 2 3 4	1 2 3 4	24. Supervise the urinalysis department.
1 2 3 4	1 2 3 4	1 2 3 4	25. Instruct students or new employees in correct protocol for urinalysis.
1 2 3 4	1 2 3 4	1 2 3 4	______________________________ ______________________________
1 2 3 4	1 2 3 4	1 2 3 4	______________________________ ______________________________
1 2 3 4	1 2 3 4	1 2 3 4	______________________________ ______________________________

CLA	MLT	MT	BLOOD BANK TASKS
1 2 3 4	1 2 3 4	1 2 3 4	26. Determine need and order blood by phone from suppliers.
1 2 3 4	1 2 3 4	1 2 3 4	27. Maintain inventory of reagents and supplies, recognizing expiration dates.
1 2 3 4	1 2 3 4	1 2 3 4	28. Assemble, organize, and maintain records, log books, donor files, recipient files.
1 2 3 4	1 2 3 4	1 2 3 4	29. Perform daily quality control of reagents and equipment.
1 2 3 4	1 2 3 4	1 2 3 4	30. Operate and control blood bank temperature alarm system.
1 2 3 4	1 2 3 4	1 2 3 4	31. Calibrate serofuges.
1 2 3 4	1 2 3 4	1 2 3 4	32. Operate and maintain automated cell washer (i.e,hemonetics,IBM).
1 2 3 4	1 2 3 4	1 2 3 4	33. Prepare reagent controls when needed.
1 2 3 4	1 2 3 4	1 2 3 4	34. Perform donor histories and physicals.
1 2 3 4	1 2 3 4	1 2 3 4	35. Perform therapeutic/donor phlebotomy.
1 2 3 4	1 2 3 4	1 2 3 4	36. Perform donor phlebotomy in emergencies.
1 2 3 4	1 2 3 4	1 2 3 4	37. Perform first aid for shock of donors.
1 2 3 4	1 2 3 4	1 2 3 4	38. Process donor blood and components for storage, shipment, or transfusion.
1 2 3 4	1 2 3 4	1 2 3 4	39. Issue crossmatched blood for transfusion.
1 2 3 4	1 2 3 4	1 2 3 4	40. Issue uncrossmatched blood in emergencies on the order of a physician.
1 2 3 4	1 2 3 4	1 2 3 4	41. Prepare packed cells from whole donor blood.
1 2 3 4	1 2 3 4	1 2 3 4	42. Perform plasmapheresis.
1 2 3 4	1 2 3 4	1 2 3 4	43. Perform leukapheresis.
1 2 3 4	1 2 3 4	1 2 3 4	44. Prepare leukocyte poor blood for transfusion.
1 2 3 4	1 2 3 4	1 2 3 4	45. Collect and prepare blood for exchange transfusion.
1 2 3 4	1 2 3 4	1 2 3 4	46. Prepare cryoprecipitate.
1 2 3 4	1 2 3 4	1 2 3 4	47. Prepare platelet concentrate.
1 2 3 4	1 2 3 4	1 2 3 4	48. Prepare frozen, glycerolized red cells utilizing a blood processor.
1 2 3 4	1 2 3 4	1 2 3 4	49. Group and type blood samples (forward and reverse) including testing for D^u and Rh phenotyping by tube agglutination.
1 2 3 4	1 2 3 4	1 2 3 4	50. Identify patient, apply ID band, draw blood and label specimen.
1 2 3 4	1 2 3 4	1 2 3 4	51. Resolve ABO grouping discrepancies.
1 2 3 4	1 2 3 4	1 2 3 4	52. Identify procedures for testing in paternity cases.
1 2 3 4	1 2 3 4	1 2 3 4	53. Perform a direct antiglobulin test:
1 2 3 4	1 2 3 4	1 2 3 4	54. Perform an indirect antiglobulin test.

CLA	MLT	MT	
1 2 3 4	1 2 3 4	1 2 3 4	55. Perform an antibody screening test.
1 2 3 4	1 2 3 4	1 2 3 4	56. Perform panel testing for antibody identification including enzyme and LISS techniques.
1 2 3 4	1 2 3 4	1 2 3 4	57. Perform an elution.
1 2 3 4	1 2 3 4	1 2 3 4	58. Perform an absorption.
1 2 3 4	1 2 3 4	1 2 3 4	59. Perform and interpret major and minor compatibility testing of donor and recipient blood.
1 2 3 4	1 2 3 4	1 2 3 4	60. Perform and interpret compatibility testing for Rh$_o$·D immune globulin (i.e.,RhoGam).
1 2 3 4	1 2 3 4	1 2 3 4	61. Perform and interpret tests for immune anti-A, anti-B.
1 2 3 4	1 2 3 4	1 2 3 4	62. Identify other blood group systems (i.e.,M,N,S,P,Fy,K).
1 2 3 4	1 2 3 4	1 2 3 4	63. Perform suitable protocol for investigating transfusion reactions.
1 2 3 4	1 2 3 4	1 2 3 4	64. Supervise blood bank procedures.
1 2 3 4	1 2 3 4	1 2 3 4	65. Instruct students in the blood bank procedures.
1 2 3 4	1 2 3 4	1 2 3 4	______________________________ ______________________________
1 2 3 4	1 2 3 4	1 2 3 4	______________________________ ______________________________

CLA	MLT	MT	SEROLOGY TASKS
1 2 3 4	1 2 3 4	1 2 3 4	66. Perform screening tests for syphilis on CSF and serum (i.e.,VDRL,RPR).
1 2 3 4	1 2 3 4	1 2 3 4	67. Perform quantitative test for syphilis and interpret results (i.e.,VDRL).
1 2 3 4	1 2 3 4	1 2 3 4	68. Perform confirmation test for syphilis (i.e., FTA-Abs).
1 2 3 4	1 2 3 4	1 2 3 4	69. Prepare specimens and send them to the state serology lab.
1 2 3 4	1 2 3 4	1 2 3 4	70. Calibrate a rotator.
1 2 3 4	1 2 3 4	1 2 3 4	71. Calibrate a pipette.
1 2 3 4	1 2 3 4	1 2 3 4	72. Perform a serial dilution and calculate results.
1 2 3 4	1 2 3 4	1 2 3 4	73. Perform and read a slide test for C-reactive protein,CRP.
1 2 3 4	1 2 3 4	1 2 3 4	74. Perform and read a test for rheumatoid factor.
1 2 3 4	1 2 3 4	1 2 3 4	75. Perform and read a test for cold agglutinins.
1 2 3 4	1 2 3 4	1 2 3 4	76. Perform and read the tube test for anti-streptolysin-O, ASO.
1 2 3 4	1 2 3 4	1 2 3 4	77. Perform and read a screening test for ASO (i.e., Streptozyme^{TM}).
1 2 3 4	1 2 3 4	1 2 3 4	78. Perform and read a slide test for infectious mononucleosis.
1 2 3 4	1 2 3 4	1 2 3 4	79. Perform a differential tube test for infectious mononucleosis.

CLA	MLT	MT	
1 2 3 4	1 2 3 4	1 2 3 4	80. Perform a latex slide test for pregnancy.
1 2 3 4	1 2 3 4	1 2 3 4	81. Perform a hemagglutination tube test for pregnancy.
1 2 3 4	1 2 3 4	1 2 3 4	82. Perform a pregnancy test by RIA.
1 2 3 4	1 2 3 4	1 2 3 4	83. Prepare serologic reagents/ cell suspensions, etc..
1 2 3 4	1 2 3 4	1 2 3 4	84. Perform and read a slide agglutination test for LE.
1 2 3 4	1 2 3 4	1 2 3 4	85. Prepare and read slides by fluorescent microscopy (i.e.,ANA).
1 2 3 4	1 2 3 4	1 2 3 4	86. Interpret specific patterns obtained in the ANA test.
1 2 3 4	1 2 3 4	1 2 3 4	87. Perform and read tests for febrile agglutinins.
1 2 3 4	1 2 3 4	1 2 3 4	88. Perform tests for immunoglobulins by laser nephelometry or fluorescence.
1 2 3 4	1 2 3 4	1 2 3 4	89. Prepare and read a hemagglutination inhibition test for rubella.
1 2 3 4	1 2 3 4	1 2 3 4	90. Perform a third generation test for Hb$_s$Ag.
1 2 3 4	1 2 3 4	1 2 3 4	91. Perform a microtiter test for thyroglobulin and microsomal autoantibody.
1 2 3 4	1 2 3 4	1 2 3 4	92. Perform viral titers by complement fixation.
1 2 3 4	1 2 3 4	1 2 3 4	93. Determine fungal antibody titers.
1 2 3 4	1 2 3 4	1 2 3 4	94. Determine complement levels (i.e., CH$_{50}$).
1 2 3 4	1 2 3 4	1 2 3 4	95. Identify C$_3$,C$_4$ and other complement components.
1 2 3 4	1 2 3 4	1 2 3 4	______________________________ ______________________________
1 2 3 4	1 2 3 4	1 2 3 4	______________________________ ______________________________

CLA	MLT	MT	CHEMISTRY TASKS
1 2 3 4	1 2 3 4	1 2 3 4	96. Collect specimens and run a glucose tolerance test.
1 2 3 4	1 2 3 4	1 2 3 4	97. Collect specimens and run a xylose tolerance test.
1 2 3 4	1 2 3 4	1 2 3 4	98. Collect specimens and run an insulin tolerance test.
1 2 3 4	1 2 3 4	1 2 3 4	99. Collect specimens for arterial blood gases.
1 2 3 4	1 2 3 4	1 2 3 4	100. Perform a test for glycosylated hemoglobin, HbA$_1$.
1 2 3 4	1 2 3 4	1 2 3 4	101. Calibrate volumetric glassware.
1 2 3 4	1 2 3 4	1 2 3 4	102. Operate an analytical balance.
1 2 3 4	1 2 3 4	1 2 3 4	103. Perform routine maintenance on equipment (i.e.,flame photometer).
1 2 3 4	1 2 3 4	1 2 3 4	104. Recognize and correct minor equipment problems.
1 2 3 4	1 2 3 4	1 2 3 4	105. Evaluate potential test procedures/kits.

CLA	MLT	MT	
1 2 3 4	1 2 3 4	1 2 3 4	106. Perform and evaluate routine quality control measures.
1 2 3 4	1 2 3 4	1 2 3 4	107. Calculate biomedical statistics related to quality control, including establishing normal values.
1 2 3 4	1 2 3 4	1 2 3 4	108. Perform proficiency testing (i.e., CAP survey).
1 2 3 4	1 2 3 4	1 2 3 4	109. Correlate and report data.
1 2 3 4	1 2 3 4	1 2 3 4	110. Carry out research on new methods.
1 2 3 4	1 2 3 4	1 2 3 4	111. Perform manual bilirubin determinations.
1 2 3 4	1 2 3 4	1 2 3 4	112. Determine serum/urine/body fluid amylase.
1 2 3 4	1 2 3 4	1 2 3 4	113. Prepare special solutions and/or reagents.
1 2 3 4	1 2 3 4	1 2 3 4	114. Perform qualitative analysis of renal calculi.
1 2 3 4	1 2 3 4	1 2 3 4	115. Set up a standard curve for a spectrophotometer.
1 2 3 4	1 2 3 4	1 2 3 4	116. Perform a quantitative test for urine total protein.
1 2 3 4	1 2 3 4	1 2 3 4	117. Calculate a creatinine and/or inulin clearance test.
1 2 3 4	1 2 3 4	1 2 3 4	118. Perform serum iron and TIBC.
1 2 3 4	1 2 3 4	1 2 3 4	119. Determine enzyme levels by manual methods.
1 2 3 4	1 2 3 4	1 2 3 4	120. Perform cholesterol and triglyceride levels.
1 2 3 4	1 2 3 4	1 2 3 4	121. Perform titration for lipase.
1 2 3 4	1 2 3 4	1 2 3 4	122. Perform analysis of gastric fluid.
1 2 3 4	1 2 3 4	1 2 3 4	123. Determine blood ethanol levels.
1 2 3 4	1 2 3 4	1 2 3 4	124. Differentiate urobilinogen and porphobilinogen by extraction or separation.
1 2 3 4	1 2 3 4	1 2 3 4	125. Perform a Schilling test.
1 2 3 4	1 2 3 4	1 2 3 4	126. Choose proper preservatives for 24-hour urine collection.
1 2 3 4	1 2 3 4	1 2 3 4	127. Determine total protein and glucose on CSF.
1 2 3 4	1 2 3 4	1 2 3 4	128. Perform a screening test for G6PD.
1 2 3 4	1 2 3 4	1 2 3 4	129. Collect specimens and determine retention of BSP.
1 2 3 4	1 2 3 4	1 2 3 4	130. Perform tubeless gastric analysis (Diagnex blue).
1 2 3 4	1 2 3 4	1 2 3 4	131. Perform tests for catecholamines.
1 2 3 4	1 2 3 4	1 2 3 4	132. Perform cholinesterase or pseudocholinesterase levels.
1 2 3 4	1 2 3 4	1 2 3 4	133. Set up and read results of tests utilizing thin layer chromatography (i.e., drug screening, amino acids).
1 2 3 4	1 2 3 4	1 2 3 4	134. Determine L/S ratio.
1 2 3 4	1 2 3 4	1 2 3 4	135. Perform basic radioimmunoassay, RIA, procedures.
1 2 3 4	1 2 3 4	1 2 3 4	136. Perform thyroid function tests (i.e., T_3, T_4).

CLA	MLT	MT	
1 2 3 4	1 2 3 4	1 2 3 4	137. Perform complex RIA procedures (i.e.,LH,FSH,IgE).
1 2 3 4	1 2 3 4	1 2 3 4	138. Perform RIA procedures for plasma renin, aldosterone, prostaglandin.
1 2 3 4	1 2 3 4	1 2 3 4	139. Set up and read simple protein electrophoresis.
1 2 3 4	1 2 3 4	1 2 3 4	140. Set up and read immunoelectrophoresis.
1 2 3 4	1 2 3 4	1 2 3 4	141. Perform isoenzyme electrophoresis for CK.
1 2 3 4	1 2 3 4	1 2 3 4	142. Perform isoenzyme electrophoresis for LD, AP.
1 2 3 4	1 2 3 4	1 2 3 4	143. Perform lipoprotein electrophoresis.
1 2 3 4	1 2 3 4	1 2 3 4	144. Perform hemoglobin electrophoresis.
1 2 3 4	1 2 3 4	1 2 3 4	145. Set up and read radial immunodiffusion for identification of immunoglobulins.
1 2 3 4	1 2 3 4	1 2 3 4	146. Perform arterial blood gases (i.e., pCO$_2$, pO$_2$).
1 2 3 4	1 2 3 4	1 2 3 4	147. Standardize a blood gas analyzer using tonometry.
1 2 3 4	1 2 3 4	1 2 3 4	148. Determine serum Na$^+$ and K$^+$ using a flame photometer.
1 2 3 4	1 2 3 4	1 2 3 4	149. Determine Lithium levels using a flame photometer.
1 2 3 4	1 2 3 4	1 2 3 4	150. Operate and calibrate a simple spectrophotometer (i.e., Coleman Jr II).
1 2 3 4	1 2 3 4	1 2 3 4	151. Determine Ca^{++} and/or Mg^{++} levels by atomic absorption.
1 2 3 4	1 2 3 4	1 2 3 4	152. Determine sweat chloride using an ion specific electrode apparatus.
1 2 3 4	1 2 3 4	1 2 3 4	153. Operate a fluorometer.
1 2 3 4	1 2 3 4	1 2 3 4	154. Operate a nephelometer.
1 2 3 4	1 2 3 4	1 2 3 4	155. Operate a laser nephelometer.
1 2 3 4	1 2 3 4	1 2 3 4	156. Perform tests utilizing a semi-automated spectrophotometer (i.e., Chemetrics, Gilford 3500).
1 2 3 4	1 2 3 4	1 2 3 4	157. Operate a continuous flow, multichannel analyzer (i.e., SMA12/60).
1 2 3 4	1 2 3 4	1 2 3 4	158. Operate a discrete analyzer (i.e., Dupont ACA, Hycel XVII, KDA).
1 2 3 4	1 2 3 4	1 2 3 4	159. Operate a centrifugal analyzer (i.e., Rotochem).
1 2 3 4	1 2 3 4	1 2 3 4	160. Operate a liquid scintillation counter.
1 2 3 4	1 2 3 4	1 2 3 4	______________________________ ______________________________
1 2 3 4	1 2 3 4	1 2 3 4	______________________________ ______________________________

TAKE A COFFEE BREAK!!

CLA	MLT	MT	MICROBIOLOGY TASKS
1 2 3 4	1 2 3 4	1 2 3 4	161. Perform initial plating of specimens.
1 2 3 4	1 2 3 4	1 2 3 4	162. Select proper media for specimens received.
1 2 3 4	1 2 3 4	1 2 3 4	163. Obtain and process specimens for throat cultures.
1 2 3 4	1 2 3 4	1 2 3 4	164. Perform a Gram stain procedure.
1 2 3 4	1 2 3 4	1 2 3 4	165. Perform stain for acid-fast organisms.
1 2 3 4	1 2 3 4	1 2 3 4	166. Perform special stains (i.e., flagella, spore, capsule).
1 2 3 4	1 2 3 4	1 2 3 4	167. Read and interpret stained slides.
1 2 3 4	1 2 3 4	1 2 3 4	168. Prepare staining reagents.
1 2 3 4	1 2 3 4	1 2 3 4	169. Set up and read India ink preparations.
1 2 3 4	1 2 3 4	1 2 3 4	170. Prepare dehydrated culture media for petri dishes.
1 2 3 4	1 2 3 4	1 2 3 4	171. Prepare biochemical media and reagents demonstrating an understanding of chemical formulae, calculations, etc..
1 2 3 4	1 2 3 4	1 2 3 4	172. Perform venipuncture and obtain blood cultures.
1 2 3 4	1 2 3 4	1 2 3 4	173. Process fecal specimens for ova and parasite identification.
1 2 3 4	1 2 3 4	1 2 3 4	174. Evaluate direct and concentrated fecal smears for the presence of diagnostic parasite forms.
1 2 3 4	1 2 3 4	1 2 3 4	175. Identify the proper procedure for collection and handling of viral specimens.
1 2 3 4	1 2 3 4	1 2 3 4	176. Process mycology specimens.
1 2 3 4	1 2 3 4	1 2 3 4	177. Prepare autogenous vaccines.
1 2 3 4	1 2 3 4	1 2 3 4	178. Perform digestion procedures and process sputum for acid-fast culture.
1 2 3 4	1 2 3 4	1 2 3 4	179. Perform identification procedures for mycobacteria.
1 2 3 4	1 2 3 4	1 2 3 4	180. Read and interpret bacteriologic cultures from plates, distinguishing normal flora from clinically significant organisms.
1 2 3 4	1 2 3 4	1 2 3 4	181. Manage identification systems for organisms (including kits).
1 2 3 4	1 2 3 4	1 2 3 4	182. Choose biochemical tests appropriate to the potential organism.
1 2 3 4	1 2 3 4	1 2 3 4	183. Read and interpret biochemical tests for organisms.
1 2 3 4	1 2 3 4	1 2 3 4	184. Identify unknowns from external quality control programs.
1 2 3 4	1 2 3 4	1 2 3 4	185. Standardize and plant inoculum for antibiotic susceptibility testing.

CLA	MLT	MT	
1 2 3 4	1 2 3 4	1 2 3 4	186. Read antibiotic susceptibility tests.
1 2 3 4	1 2 3 4	1 2 3 4	187. Determine minimum bactericidal concentrations (MBC).
1 2 3 4	1 2 3 4	1 2 3 4	188. Determine minimum inhibitory concentrations (MIC).
1 2 3 4	1 2 3 4	1 2 3 4	189. Determine blood levels of antibiotics in patients.
1 2 3 4	1 2 3 4	1 2 3 4	190. Determine serumcidal levels (Schlichter test).
1 2 3 4	1 2 3 4	1 2 3 4	191. Identify pathogens serologically or by biotyping.
1 2 3 4	1 2 3 4	1 2 3 4	192. Interpret and report data.
1 2 3 4	1 2 3 4	1 2 3 4	193. Perform quality control procedures for microbiology.
1 2 3 4	1 2 3 4	1 2 3 4	194. Perform record-keeping procedures.
1 2 3 4	1 2 3 4	1 2 3 4	195. Instruct students at the "bench".
1 2 3 4	1 2 3 4	1 2 3 4	196. Evaluate student progress.
1 2 3 4	1 2 3 4	1 2 3 4	197. Supervise bacteriology procedures.
1 2 3 4	1 2 3 4	1 2 3 4	198. Correlate epidemiologic data.
1 2 3 4	1 2 3 4	1 2 3 4	199. Serve on a hospital infection control committee.
1 2 3 4	1 2 3 4	1 2 3 4	200. Identify and carry out protocol for managing bacteriologic spills.
1 2 3 4	1 2 3 4	1 2 3 4	201. Evaluate sputum samples microscopically to determine suitability for culture.
1 2 3 4	1 2 3 4	1 2 3 4	202. Prepare and evaluate smears of mycological agents using lactophenol cotton blue, KOH, or equivalent.
1 2 3 4	1 2 3 4	1 2 3 4	203. Observe growth and manage identification schemes for fungi.
1 2 3 4	1 2 3 4	1 2 3 4	204. Perform "inhouse" culture surveillance procedures.
1 2 3 4	1 2 3 4	1 2 3 4	205. Perform fluorescent antibody procedures.
1 2 3 4	1 2 3 4	1 2 3 4	206. Use a fluorescent microscope observing safety precautions.
1 2 3 4	1 2 3 4	1 2 3 4	207. Operate an autoclave to sterilize media.
1 2 3 4	1 2 3 4	1 2 3 4	208. Use anaerobic devices including Gas-Pak^{TM} jars.
1 2 3 4	1 2 3 4	1 2 3 4	209. Operate a gas chromatograph to identify anaerobes.
1 2 3 4	1 2 3 4	1 2 3 4	210. Operate an Autobac^{TM} and a Bactec^{TM}.
1 2 3 4	1 2 3 4	1 2 3 4	211. Carry out purchase and inventory control on reagents/media.
1 2 3 4	1 2 3 4	1 2 3 4	212. Use proper technique in processing highly infectious specimens
1 2 3 4	1 2 3 4	1 2 3 4	213. Select and evaluate new procedures.
1 2 3 4	1 2 3 4	1 2 3 4	214. Perform plating for quantitative cultures (i.e., urines).

This is the last section!!!

CLA	MLT	MT	HEMATOLOGY TASKS
1 2 3 4	1 2 3 4	1 2 3 4	215. Collect blood by venipuncture from adults and children.
1 2 3 4	1 2 3 4	1 2 3 4	216. Collect capillary blood from adults and children.
1 2 3 4	1 2 3 4	1 2 3 4	217. Prepare peripheral blood smears from EDTA tubes, from the needle at bedside, and from fingersticks.
1 2 3 4	1 2 3 4	1 2 3 4	218. Perform and calculate manual WBC and RBC counts.
1 2 3 4	1 2 3 4	1 2 3 4	219. Perform and calculate eosinophil, CSF, and sperm counts using the hemocytometer and microscope.
1 2 3 4	1 2 3 4	1 2 3 4	220. Perform WBC and RBC counts using an automated cell counter.
1 2 3 4	1 2 3 4	1 2 3 4	221. Operate a Coulter^{TM} Model S, Sr, S$^+$, or equivalent.
1 2 3 4	1 2 3 4	1 2 3 4	222. Perform quality control, including attenuation, of a Coulter^{TM} Model S, Sr, S$^+$, or equivalent.
1 2 3 4	1 2 3 4	1 2 3 4	223. Perform general maintenance and quality control of instruments used in hematology.
1 2 3 4	1 2 3 4	1 2 3 4	224. Set up and read erythrocyte sedimentation rates.
1 2 3 4	1 2 3 4	1 2 3 4	225. Set up and read an erythrocyte osmotic fragility test.
1 2 3 4	1 2 3 4	1 2 3 4	226. Perform a confirmation test for PNH.
1 2 3 4	1 2 3 4	1 2 3 4	227. Perform the cyanmethemoglobin procedure including preparation of the standard curve.
1 2 3 4	1 2 3 4	1 2 3 4	228. Perform a spun hematocrit.
1 2 3 4	1 2 3 4	1 2 3 4	229. Calibrate a microhematocrit centrifuge.
1 2 3 4	1 2 3 4	1 2 3 4	230. Prepare reagents for a Romanowsky stain (i.e., Wright's).
1 2 3 4	1 2 3 4	1 2 3 4	231. Stain peripheral blood smears with Wright's stain.
1 2 3 4	1 2 3 4	1 2 3 4	232. Prepare reagents and stain blood smears with supravital dyes (i.e., New Methylene blue, brilliant cresyl blue).
1 2 3 4	1 2 3 4	1 2 3 4	233. Prepare smears for identification of Heinz bodies.
1 2 3 4	1 2 3 4	1 2 3 4	234. Perform a reticulocyte count.
1 2 3 4	1 2 3 4	1 2 3 4	235. Assist pathologist with bone marrow aspirates/biopsies.
1 2 3 4	1 2 3 4	1 2 3 4	236. Make smears from bone marrow aspirates.

Hang in there!

CLA	MLT	MT	
1 2 3 4	1 2 3 4	1 2 3 4	237. Perform cytochemical staining (i.e., LAP, peroxidase).
1 2 3 4	1 2 3 4	1 2 3 4	238. Read and interpret slides prepared with cytochemical stains.
1 2 3 4	1 2 3 4	1 2 3 4	239. Examine peripheral blood smears for normal RBC morphology, normal WBC differential, and platelet estimate.
1 2 3 4	1 2 3 4	1 2 3 4	240. Estimate the WBC from the peripheral blood smear.
1 2 3 4	1 2 3 4	1 2 3 4	241. Examine peripheral blood smears for WBC abnormalities and classify cells identified (i.e., CLL, ALL, CGL, myeloma cells, reactive lymphocytes).
1 2 3 4	1 2 3 4	1 2 3 4	242. Examine peripheral blood smears for RBC abnormal morphology and identify cells (i.e., schistocytes, spherocytes).
1 2 3 4	1 2 3 4	1 2 3 4	243. Operate and perform basic troubleshooting of automated differential instruments (i.e., LARC, Hematrak).
1 2 3 4	1 2 3 4	1 2 3 4	244. Examine peripheral blood smear for platelet abnormalities.
1 2 3 4	1 2 3 4	1 2 3 4	245. Correlate platelet estimate from peripheral blood smear with automated or phase platelet count.
1 2 3 4	1 2 3 4	1 2 3 4	246. Perform and calculate platelet counts by Rees-Ecker or phase microscopic methods.
1 2 3 4	1 2 3 4	1 2 3 4	247. Perform and calculate platelet counts by automated instrument.
1 2 3 4	1 2 3 4	1 2 3 4	248. Recognize logical test results and correlate them with other hematology tests.
1 2 3 4	1 2 3 4	1 2 3 4	249. Identify abnormal hemoglobins by screening tests.
1 2 3 4	1 2 3 4	1 2 3 4	250. Confirm the presence of abnormal hemoglobins by electrophoresis.
1 2 3 4	1 2 3 4	1 2 3 4	251. Perform a hematologic or serologic test for LE.
1 2 3 4	1 2 3 4	1 2 3 4	252. Perform a test for HbA_2 by column.
1 2 3 4	1 2 3 4	1 2 3 4	253. Perform a test for 2-3, DPG.
1 2 3 4	1 2 3 4	1 2 3 4	254. Perform the major screening tests for hemostasis and correlate them with vascular, platelet, and coagulation disorders.
1 2 3 4	1 2 3 4	1 2 3 4	255. Perform an Ivy template bleeding time.
1 2 3 4	1 2 3 4	1 2 3 4	256. Perform a thrombin time test.
1 2 3 4	1 2 3 4	1 2 3 4	257. Perform a whole blood clotting time test.
1 2 3 4	1 2 3 4	1 2 3 4	258. Perform manual or automated prothrombin time tests and partial thromboplastin time tests.
1 2 3 4	1 2 3 4	1 2 3 4	259. Perform a quantitative test for fibrinogen.

CLA	MLT	MT	
1 2 3 4	1 2 3 4	1 2 3 4	260. Perform factor substitution assays.
1 2 3 4	1 2 3 4	1 2 3 4	261. Perform specific factor assays, (i.e., Factor VIII).
1 2 3 4	1 2 3 4	1 2 3 4	262. Perform a test for fibrin split products (i.e., Thrombowellcotest™).
1 2 3 4	1 2 3 4	1 2 3 4	263. Perform a test for protamine sulfate.
1 2 3 4	1 2 3 4	1 2 3 4	264. Perform a test for platelet aggregation using an aggregometer and various aggregating agents including epinephrine and ADP.
1 2 3 4	1 2 3 4	1 2 3 4	265. Perform a test for clot retraction.
1 2 3 4	1 2 3 4	1 2 3 4	266. Perform a test for euglobulin lysis.
1 2 3 4	1 2 3 4	1 2 3 4	267. Perform tests to monitor heparin and coumarin therapy.
1 2 3 4	1 2 3 4	1 2 3 4	268. Operate an automated coagulation analyzer (i.e., Coagulyzer™).
1 2 3 4	1 2 3 4	1 2 3 4	269. Perform a urea solubility test for Factor XIII.
1 2 3 4	1 2 3 4	1 2 3 4	270. Examine bone marrow smears.
1 2 3 4	1 2 3 4	1 2 3 4	____ ____

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Thank you for enduring!

Please return this form with your completed biographical data form (next page) by MAY 7, 1980 to:

JUDITH A DAVIS
ALLIED HEALTH DEPARTMENT
SANDHILLS COMMUNITY COLLEGE
ROUTE 3, BOX 182-C
CARTHAGE, NORTH CAROLINA 28327

APPENDIX C

BIOGRAPHICAL DATA FORMS

COMPETENCY BASED
MEDICAL LABORATORY TECHNOLOGY
CURRICULUM STUDY
BIOGRAPHICAL DATA FORM

Please complete the following questions concerning your medical laboratory work. Your results will be tabulated along with those of others, and no individual responses will be disclosed. PLEASE CIRCLE RESPONSES.

1. My certification or level of training is

A. CLA(ASCP)
B. MLT(ASCP)
C. MLT [AMT]
D.MT(ASCP)
E. MT [AMT]
F.MT [HEW]
G. MT, other
H.specialist, ASCP
I. other, specify ______________

2 My highest degree is

A. certificate
B. associate degree
C. bachelor's degree
D. masters degree
E. professional degree, MD, DO
F. doctorate, EdD, PhD
G. other, specify ______________

3. I am employed as a (an)

A. staff technician
B. staff technologist
C. section chief
D. chief technologist
E. laboratory manager
F. clinical instructor
G. CLA, MLT, or MT campus instructor
H. education coordinator
I. other, specify ______________

4. The following describes by place of employment:

A. hospital, less than 100 beds
B. hospital, 100 to 200 beds
C. hospital, 200 to 300 beds
D. hospital, over 300 beds
E. community college
F. technical college/institute
G. four-year college
H. university
I. other, specify ______________

5. I have approximately ______ *years experience in laboratory work/education.*

6. The specialty in which I work most often is (circle all that apply)

A. Bacteriology
B. Blood bank
C. Chemistry
D. Coagulation
E. Education
F. Hematology
G. Management
H. Mycology
I. Special chemistry
J. Urinalysis
K. other, specify ______________

7. My primary responsibilities are the following (circle all that apply):

A. routine performance of tests
B. scheduling
C. shift supervisor
D. teaching
E. inventory, ordering
F. phlebotomist
G. quality control
H. floater
I. section chief
J. other, specify ______________

8. *The approximate number of continuing education meetings I have attended during the last 12 months is (give the number in each area that relates to you)*

A. Blood bank
B. Chemistry
C. Education
D. Hematology
F. Microbiology
G. Serology
H. Urinalysis
I. other, specify __________

9. *The number of each of the following types of employees works in my lab or school:*

A. MT(ASCP) ______
B. MT [HEW] _______
C. MLT(ASCP) _______
D. MLT, other ______
E. CLA(ASCP) _____
F. other, specify ____

10. *The county in which I work is* ____________

COMPETENCY BASED
MEDICAL LABORATORY TECHNOLOGY
CURRICULUM STUDY
BIOGRAPHICAL DATA FORM

Zip code__________ Class of_______

Please complete the following questions concerning your medical laboratory training and subsequent work experience. Your results will be tabulated along with those of others and no individual responses will be disclosed. PLEASE CIRCLE RESPONSES.

1. I am presently working in an area related to my field of study:
   A. Yes (proceed to question 3) B. No (proceed to question 2)

2. The main reason I am not working in the laboratory field is that I
   A. could not find a lab job B. did not like lab work C. could not find a job locally
   D. have family responsibilities E. am a full-time student F. preferred a change
   G. other, specify___________

3. The place of my *first* employment following my laboratory training was (is) a
   A. state lab or Red Cross B. hospital, 50-100 beds C. hospital, 100-200 beds
   D. hospital, over 200 beds E. clinic F. physician's office
   G. diagnostic reagent company H. health department I. community college/technical institute
   J. other, lab work____________________ K. other, non-lab work______________________

4. Using the choices in question 3, the place of my *present or most recent* employment is (circle response)
   A. B. C. D. E. F. G. H. I. J. K.

5. The geographical area in which I work can be categorized as
   A. urban (>50,000 people) B. metropolitan (>250,000) C. small city (25,000 to 50,000 people)
   D. town (10,000 to 25,000 people) E. small town (5,000 to 10,000) F. rural area (<5,000 people)
   G. other, specify____________

6. Since graduation I have been working
   A. less than one year B. one to three years C. three to five years D. more than five years

7. The specialty in which I work most often is (circle all that apply):
   A. Bacteriology B. Blood Bank C. Chemistry D. Education
   E. Hematology F. Management G. Mycology H. Parasitology
   I. Serology J. Special chemistry K. Urinalysis L. Other, specify______________

8. My primary responsibilities are the following (circle all that apply):
   A. routine performance of tests B. inventory, ordering C. quality control
   D. scheduling hours to be worked E. assigning work stations F. "floater"
   G. shift supervisor H. phlebotomist I. section head
   J. teaching K. other, specify____________________

9. Since graduation from my laboratory training program, my formal education has been (is)
   A. some college B. bachelor's degree C. some graduate work
   D. master's degree F. none yet F. none, no plans

10. The approximate number of continuing education workshops I have attended during the past year is the following (give the number in each area):
    A. Blood banking_____ B. Chemistry_______ C. Education _______
    D. Hematology________ E. Management_____ F. Microbiology_______
    G. Serology__________ H. Urinalysis_______ I. Other, specify______

EVALUATION OF THE MLT PROGRAM AT SANDHILLS COMMUNITY COLLEGE

A. Please rate each of the didactic (lecture) courses you took while enrolled in the MLT program. Circle your response.

1. Introduction to MLT I (general orientation course, MLT 110)

4	3	2	1
material well organized and of sufficient depth and information	generally good preparation for MLT 111	adequate orientation	poor organization and depth; of little value

2. Introduction to MLT II (math, terminology, introduction of subject areas, MLT 111)

4	3	2	1
material of appropriate difficulty, well organized and beneficial	adequate introduction	material too hard or not helpful on the certifying exam	material too easy; poorly organized

3. Medical Laboratory Instrumentation (MLT 112)

4	3	2	1
information prepared me for clinical	good course but not of sufficient depth	adequate introduction	of little value in clinical; can learn it on the job

4. Hematology/Urinalysis lecture (MLT 201)

4	3	2	1
well organized and of sufficient depth	interesting; prepared me for certification exam	adequate for certification exam and for work	too much theory; over my head.

5. Clinical Chemistry lecture (MLT 202)

4	3	2	1
interesting, moderately difficult; good preparation for work	good course, but should have been more practical	adequate for certification exam and for work	of little or no value

6. Microbiology lecture (MLT 203)

4	3	2	1
excellent material; good preparation.	adequate for certification exam and for work	of some value; not enough preparation for work	of little or no value

7. Blood Banking/Serology lecture (MLT 204)

4	3	2	1
prepared me for understanding concepts in blood bank	adequate for certification exam and for work	of some value	course did not prepare me to work in blood bank

B. How would you rate the MLT courses on campus (lecture and lab) in each of the following areas? Attempt to make a mental average of all MLT campus courses.

8. Organization and presentation of material

4	3	2	1
material very well organized	material satisfactorily organized	sometimes organized	poorly organized

9. Depth of material being presented

4	3	2	1
more difficult than necessary	of sufficient depth	average courses; not too difficult	easier than necessary

10. Textbooks

4	3	2	1
very difficult; not for MLT level	moderately difficult, but helpful	just right for MLTs	too simple

11. Preparation for clinical experience

4	3	2	1
the courses prepared me to perform well in clinical	adequate preparation for clinical	some preparation, but not enough	poor preparation; I was confused in clinical

12. On-campus laboratories

4	3	2	1
excellent preparation for clinical	adequate preparation for clinical labs	good labs, but should have coincided more closely with lecture	waste of time because_____ __________ __________

C. Comment on your feelings concerning the clinical (hospital) rotations:

13. Estimate of learning experiences in hospitals (clinical facilities)

4	3	2	1
excellent; I was well prepared for work	good in most areas; weaker in others	provided satisfactory learning experiences	did not prepare me for work

14. Length of clinical experience

4	3	2	1
too little time in clinical; would have liked to spend more time	sufficient time	sufficient time in all areas except: ____	too much time in clinical; would have liked to spend less time

15. Location of clinical experience

4	3	2	1
hospital was too far away	good location	hospital was adequate, but I may have missed something by staying there	would have liked to rotate among hospitals

16. Amount of patient contact

4	3	2	1
received too much patient contact;	received much patient contact;	had some contact with patients, but would have liked more	very seldom saw patients; needed more patient contact

17. Attitude of laboratory personnel in clinical affiliates

4	3	2	1
always willing to help; seemed to enjoy teaching	willing to help, but had too little time for teaching	usually helpful; did not seem to mind teaching	no-help at all; seemed to consider students a bother

18. Attitude toward clinical experience as a whole

4	3	2	1
I enjoyed clinical more than I expected	the days were long, but it was a good experience	the clinical experience was satisfactory	I did not like the work or the environment.

D. Comment on your general feelings concerning the profession/program.

19. Confidence in the profession

4	3	2	1
I feel confident in my laboratory work	I can do the work; but I could have used more training	I can do the tests, but I often hesitate on making decisions	I am often unsure of myself in lab work

20. Attitude toward the profession

4	3	2	1
lab techs are important and should be involved in professional societies	the profession is good, but MLTs deserve more recognition	generally a good field; I am not interested in outside meetings or lab activities	lab techs are not important, but it is an OK job

21. Overall estimate of the MLT program at Sandhills

4	3	2	1
good program; gets you a good job	good program, but it had a lot of growing pains	average program; gets you a job	dull, disappointing

22. Evaluation of faculty

4	3	2	1
helpful, concerned faculty	concerned to a degree	concerned and helpful some of the time	poor teachers; not concerned about students

General comments concerning the program and ways you feel it could be improved are welcomed:

____

____

____

____

Thank you for participating in this survey. The data obtained will provide useful information for our program and for the accrediting agency.

Return immediately in the enclosed envelope to:

ALLIED HEALTH DEPARTMENT
SANDHILLS COMMUNITY COLLEGE
ROUTE 3, BOX 182-C , CARTHAGE, NC, 28327

APPENDIX D

FOLLOW-UP POSTCARD TO NON-RESPONDENTS

May 26, 1980

Just a reminder to ask you to return your task analysis questionniare. Your support in this project is important to ensure validity of the data. Please return the questionnaires by June 6, 1980. Thank you for your assistance.

Judith A. Davis, Allied Health
Sandhills Community College
Route 3, Box 182-C
Carthage, North Carolina 28327

APPENDIX E

LETTER AND POSTCARD TO CHIEF TECHNOLOGISTS CONCERNING STAFFING

Sandhills Community College

ROUTE 3. BOX 182-C
CARTHAGE. NORTH CAROLINA 28327
PHONE 919-692-6185

June 12, 1980

Dear Colleague:

Thank you for participating in the task analysis project for the Department of Community Colleges. The data are now being compiled and we hope to have the results by September. We will make these results available to you by either distribution or publication.

I hope you will take a minute during your coffee break this morning to answer the questions on the enclosed post card. In order to have valid and meaningful data, we need your response.

Please drop the card in the mail to us today. These data, along with the task analysis information, will assist us in evaluating the need for various levels of laboratorians in our state.

Thank you again for all your help.

Sincerely yours,

Judith A. Davis, MT(ASCP)

cem

Enclosure: Postcard

My best estimate of the number of persons employed in my lab for each category for the years indicated is:

# 1970	# 1980
____MT(ASCP)	____MT(ASCP)
____MLT(ASCP)	____MLT(ASCP)
____CLA(ASCP)	____CLA(ASCP)
____Other,specify _____________	____Other,specify _____________

APPENDIX F

FREQUENCY DISTRIBUTIONS FOR ALL TASKS

TABLE 35

TOTAL FREQUENCY DISTRIBUTIONS ON MT, MLT, AND CLA RATINGS FOR EACH TASK OF THE QUESTIONNAIRE

Task		MT(n=84)					MLT(n=93)					CLA(n=83)				
Number	Keywords	4	3	2	1	M	4	3	2	1	M	4	3	2	1	M
Urinalysis																
U001	macroscopic	81 (99%)	1 (1%)			2	80 (87%)	11 (12%)	1 (1%)		1	51 (64%)	20 (25%)	7 (9%)	2 (3%)	3
U002	dipstix	82 (100%)				2	89 (97%)	3 (3%)			1	60 (75%)	18 (22%)	1 (1%)	1 (1%)	3
U003	interpret	81 (99%)	1 (1%)			2	79 (86%)	12 (13%)	1 (1%)		1	46 (58%)	25 (31%)	7 (9%)	2 (2%)	3
U004	reducing	81 (99%)	1 (1%)			2	76 (83%)	15 (16%)	1 (1%)		1	48 (60%)	14 (18%)	12 (15%)	6 (7%)	3
U005	confirm	78 (95%)	4 (5%)			2	64 (70%)	27 (29%)	1 (1%)		1	28 (35%)	24 (30%)	21 (26%)	7 (9%)	3
U006	false +	68 (83%)	14 (17%)			2	45 (49%)	39 (42%)	8 (9%)		1	16 (22%)	25 (35%)	22 (31%)	9 (12%)	11
U007	ASA-stix	74 (90%)	6 (7%)	2 (2%)		2	61 (68%)	18 (20%)	8 (9%)	3 (3%)	3	33 (42%)	23 (29%)	15 (19%)	8 (10%)	4
U008	C-stix	71 (88%)	7 (9%)	3 (3%)		2	57 (63%)	22 (24%)	7 (8%)	4 (4%)	3	31 (39%)	23 (29%)	17 (22%)	8 (10%)	4
U009	albumin	77 (94%)	5 (6%)			2	70 (76%)	19 (21%)	2 (2%)	1 (1%)	1	39 (49%)	22 (28%)	15 (19%)	3 (4%)	4
U010	Bence-Jones	76 (94%)	5 (6%)			3	55 (60%)	29 (32%)	5 (6%)	2 (2%)	2	21 (27%)	26 (33%)	24 (31%)	7 (14%)	5
U011	UBG	69 (85%)	11 (14%)	1 (1%)		3	44 (49%)	38 (42%)	6 (7%)	3 (3%)	2	17 (22%)	21 (27%)	29 (37%)	11 (14%)	5
U012	myoglobin	60 (76%)	16 (20%)	2 (3%)	1 (1%)	5	38 (43%)	34 (38%)	12 (14%)	5 (6%)	4	9 (12%)	28 (37%)	20 (27%)	18 (24%)	8
U013	SG	81 (99%)		1 (1%)		2	90 (98%)	2 (2%)			1	70 (88%)	8 (10%)	2 (2%)		3

(Continued)

M=missing cases

Note: percentages have been rounded off

Table 35 - Continued

Task		MT(n=84)					MLT(n=93)					CLA(n=83)				
Number	keywords	4	3	2	1	M	4	3	2	1	M	4	3	2	1	M
U014	dil. SG	78	2	1		3	77	12	1	1	2	38	24	14	2	5
		(96%)	(3%)	(1%)			(85%)	(13%)	(1%)	(1%)		(48%)	(31%)	(18%)	(3%)	
U015	osmolality	72	9			3	51	33	6	1	2	17	29	26	7	4
		(89%)	(11%)				(57%)	(36%)	(7%)	(1%)		(22%)	(37%)	(33%)	(9%)	
U016	correlate	58	19	4		3	15	44	26	6	2	9	15	21	34	4
		(72%)	(24%)	(5%)		3	(17%)	(48%)	(29%)	(7%)		(11%)	(19%)	(27%)	(43%)	
U017	microscopic	72	10			2	58	30	3	1	1	26	31	15	7	4
		(88%)	(12%)			2	(63%)	(33%)	(3%)	(1%)		(33%)	(39%)	(19%)	(9%)	
U018	stains	66	13	2		3	45	37	8	1	2	17	26	28	8	4
		(81%)	(16%)	(3%)			(50%)	(41%)	(23%)	(8%)		(22%)	(33%)	(35%)	(10%)	
U019	crystals/PL	55	22	4	1	2	26	38	21	7	1	9	17	29	25	3
		(67%)	(27%)	(5%)	(1%)		(28%)	(42%)	(23%)	(7%)		(11%)	(21%)	(36%)	(31%)	
U020	lipids	54	18	8	1	3	22	38	23	6	4	9	15	30	25	4
		(67%)	(22%)	(10%)	(1%)		(25%)	(43%)	(26%)	(7%)		(11%)	(19%)	(38%)	(32%)	
U021	synovial	62	18	1		3	39	35	15	1	3	14	23	26	17	3
		(77%)	(22%)	(1%)			(43%)	(39%)	(17%)	(1%)		(18%)	(29%)	(33%)	(20%)	
U022	mucin clot	56	17	6	2	3	34	29	17	3	2	13	17	26	27	3
		(69%)	(21%)	(7%)	(3%)		(37%)	(32%)	(19%)	(2%)		(16%)	(20%)	(32%)	(32%)	
U023	QC	75	8			1	31	40	17	3	2	13	17	26	27	3
		(90%)	(10%)				(34%)	(44%)	(19%)	(2%)		(16%)	(20%)	(32%)	(32%)	
U024	supervise	73	9	1		1	32	28	19	14	1	11	19	22	28	3
		(88%)	(11%)	(1%)			(34%)	(30%)	(20%)	(15%)		(14%)	(24%)	(27%)	(35%)	
U025	teach	75	8			1	39	33	16	4	1	11	19	22	28	3
		(90%)	(10%)				(42%)	(36%)	(17%)	(4%)		(14%)	(24%)	(27%)	(35%)	
Mean frequencies:		71	9	1.4	.2		53	27	9	3		26	21	19	13	
Mean percentage:		(87%)	(11%)	(1.7%)	(.2%)		(58%)	(29%)	(10%)	(3%)		(33%)	(27%)	(24%)	(17%)	
Mean on urinalysis:			3.85						3.41					2.80		

M = missing values, not included in percentages

Table 35 - Continued

Task		MT(n=84)				MLT(n=93)				CLA(n=83)			
Number	Keywords	4	3	2	1	4	3	2	1	4	3	2	1
Blood Bank													
B026	order blood	79 (95%)	4 (5%)			44 (48%)	34 (37%)	11 (12%)	2 (2%)	16 (20%)	18 (22%)	27 (33%)	20 (25%)
B027	inventory	79 (95%)	3 (5%)			61 (67%)	25 (27%)	5 (5%)	1 (1%)	23 (28%)	20 (25%)	23 (28%)	12 (15%)
B028	records	73 (89%)	9 (11%)			45 (48%)	31 (33%)	12 (13%)	3 (7%)	17 (21%)	20 (25%)	27 (33%)	17 (21%)
B029	QC	75 (90%)	8 (10%)			62 (68%)	26 (28%)	3 (3%)	1 (1%)	26 (32%)	26 (32%)	17 (21%)	12 (15%)
B030	T°alarm	72 (88%)	10 (11%)	1 (1%)		59 (65%)	24 (26%)	7 (8%)	1 (1%)	29 (36%)	26 (32%)	17 (21%)	9 (11%)
B031	calibrate	74 (89%)	8 (10%)	1 (1%)		42 (46%)	33 (36%)	14 (15%)	3 (4%)	12 (15%)	19 (23%)	28 (35%)	20 (25%)
B032	hemonetics	72 (87%)	10 (12%)	1 (1%)		51 (55%)	31 (34%)	9 (10%)	1 (1%)	10 (12%)	25 (31%)	22 (27%)	13 (16%)
B033	controls	71 (86%)	10 (12%)	1 (1%)		30 (33%)	44 (49%)	11 (12%)	5 (6%)	9 (11%)	17 (21%)	30 (37%)	24 (30%)
B034	donor Hx	70 (86%)	10 (12%)	2 (2%)		58 (63%)	22 (24%)	9 (10%)	3 (3%)	33 (41%)	16 (20%)	19 (23%)	12 (15%)
B035	phlebotomy	65 (80%)	15 (18%)	1 (1%)		50 (54%)	30 (33%)	12 (13%)		21 (26%)	20 (25%)	20 (25%)	19 (23%)
B036	ER donor	68 (83%)	13 (16%)	1 (1%)		46 (50%)	31 (34%)	13 (14%)	2 (2%)	19 (23%)	25 (31%)	16 (20%)	20 (25%)
B037	first aid	45 (55%)	21 (26%)	11 (13%)	5 (6%)	30 (33%)	31 (34%)	19 (21%)	12 (13%)	9 (11%)	18 (22%)	20 (25%)	29 (36%)
B038	process	74 (90%)	7 (9%)	1 (1%)		49 (53%)	36 (39%)	5 (5%)	2 (2%)	16 (20%)	23 (28%)	24 (30%)	17 (21%)

(Continued)

Table 35 - Continued

Task		MT(n=84)				MLT(n=93)				CLA(n=83)			
Number	keywords	4	3	2	1	4	3	2	1	4	3	2	1
B039	issue blood	78 (95%)	5 (5%)			69 (75%)	20 (22%)	3 (3%)		27 (33%)	25 (31%)	13 (16%)	16 (20%)
B040	non XM	73 (90%)	6 (7%)	2 (2%)		48 (52%)	23 (25%)	16 (5%)	5 (13%)	15 (19%)	14 (18%)	22 (27%)	29 (36%)
B041	pack cells	76 (92%)	7 (8%)			68 (75%)	14 (15%)	9 (9%)		39 (49%)	13 (16%)	10 (12%)	17 (21%)
B042	plasmapher.	29 (36%)	16 (20%)	18 (23%)	17 (22%)	20 (25%)	27 (34%)	32 (40%)		3 (4%)	7 (9%)	25 (32%)	42 (53%)
B043	leukapher.	41 (52%)	20 (25%)	7 (9%)	11 (14%)	11 (13%)	52 (63%)	20 (24%)		2 (3%)	4 (5%)	23 (29%)	49 (55%)
B044	WBC-poor	44 (55%)	19 (24%)	8 (10%)	9 (11%)	16 (18%)	20 (22%)	35 (39%)	19 (21%)	7 (9%)	7 (9%)	21 (26%)	44 (56%)
B045	Ex Tx	56 (68%)	17 (21%)	7 (9%)	2 (2%)	24 (26%)	35 (38%)	23 (25%)	10 (11%)	8 (10%)	8 (10%)	21 (26%)	43 (54%)
B046	cryoppt.	43 (54%)	19 (24%)	12 (15%)	6 (8%)	16 (18%)	21 (23%)	34 (38%)	19 (21%)	8 (10%)	8 (10%)	21 (26%)	44 (55%)
B047	platelets	44 (55%)	23 (29%)	7 (8%)	6 (7%)	18 (23%)	21 (26%)	25 (27%)	16 (20%)	7 (9%)	8 (10%)	21 (26%)	44 (55%)
B048	frozen rbc	46 (58%)	14 (18%)	11 (14%)	9 (11%)	16 (18%)	26 (29%)	28 (31%)	19 (21%)	7 (9%)	8 (10%)	19 (24%)	47 (58%)
B049	Gp & type	78 (95%)	5 (5%)			70 (76%)	17 (18%)	5 (5%)		33 (42%)	21 (27%)	15 (19%)	10 (3%)
B050	ID patient	82 (99%)	1 (1%)			87 (95%)	4 (4%)	1 (1%)		69 (85%)	5 (6%)	3 (4%)	4 (5%)
B051	ABO prob.	67 (81%)	15 (18%)	1 (1%)		28 (30%)	47 (51%)	16 (17%)	1 (1%)	5 (6%)	13 (16%)	32 (40%)	30 (38%)
B052	paternity	52 (63%)	20 (24%)	7 (8%)	3 (4%)	27 (29%)	26 (28%)	24 (25%)	14 (15%)	3 (4%)	7 (9%)	18 (23%)	50 (64%)
B053	Direct AGT	80 (96%)	3 (4%)			76 (83%)	13 (14%)	2 (3%)	1 (1%)	34 (42%)	17 (22%)	13 (16%)	16 (20%)

(Continued)

Table 35 - Continued

Task		MT(n=84)				MLT(n=93)				CLA(n=83)			
Number	keywords	4	3	2	1	4	3	2	1	4	3	2	1
B054	Ind. AGT	80 (96%)	3 (4%)			76 (83%)	13 (14%)	2 (3%)	1 (1%)	34 (42%)	17 (22%)	13 (16%)	16 (20%)
B055	AST	78 (94%)	5 (6%)			65 (71%)	24 (26%)	10 (11%)	6 (7%)	4 (5%)	19 (25%)	32 (40%)	24 (30%)
B056	panel	65 (79%)	13 (16%)	3 (4%)	1 (1%)	37 (41%)	37 (41%)	10 (11%)	6 (7%)	4 (5%)	19 (25%)	32 (40%)	24 (30%)
B057	elution	65 (79%)	18 (21%)			30 (33%)	43 (47%)	17 (19%)	1 (1%)	4 (5%)	14 (17%)	32 (40%)	30 (38%)
B058	absorption	64 (78%)	17 (20%)	1 (1%)	1 (1%)	28 (30%)	38 (42%)	20 (22%)	5 (5%)	4 (5%)	12 (15%)	35 (44%)	30 (38%)
B059	XM	79 (95%)	3 (3%)		1 (1%)	66 (72%)	21 (23%)	3 (3%)		20 (22%)	24 (26%)	19 (21%)	19 (21%)
B060	RhoGam	78 (94%)	5 (6%)			66 (72%)	21 (23%)	3 (3%)		12 (15%)	15 (18%)	28 (35%)	26 (32%)
B061	immune abs.	64 (78%)	16 (19%)	2 (2%)	1 (1%)	36 (39%)	38 (42%)	14 (15%)	4 (5%)	12 (15%)	15 (18%)	28 (35%)	26 (32%)
B062	other gps	66 (79%)	14 (17%)	3 (3%)		34 (37%)	35 (38%)	18 (20%)	5 (5%)	11 (14%)	17 (20%)	21 (26%)	32 (40%)
B063	Tx rxns	70 (84%)	13 (16%)			45 (49%)	29 (32%)	15 (16%)	2 (2%)	10 (12%)	17 (21%)	26 (32%)	28 (35%)
B064	supervise	71 (85%)	12 (15%)			22 (24%)	24 (26%)	29 (32%)	16 (18%)	2 (2%)	5 (6%)	19 (23%)	53 (65%)
B065	instruct	70 (84%)	13 (16%)			26 (28%)	29 (32%)	23 (25%)	13 (14%)	3 (3%)	5 (6%)	19 (24%)	51 (65%)
Mean frequencies:		66	11	3	2	38	28	14	3	16	15	22	27
Mean percentage:		(80%)	(13%)	(4%)	(2%)	(46%)	(34%)	(17%)	(4%)	(20%)	(19%)	(28%)	(34%)
Mean on blood bank:		3.81				3.16				2.40			

Table 35 - Continued

Task Number	Task Keywords	MT(n=84) 4	MT(n=84) 3	MT(n=84) 2	MT(n=84) 1	MLT(n=93) 4	MLT(n=93) 3	MLT(n=93) 2	MLT(n=93) 1	CLA(n=83) 4	CLA(n=83) 3	CLA(n=83) 2	CLA(n=83) 1
Serology													
S066	VDRL	77 (93%)	6 (7%)			74 (81%)	16 (17%)	1 (1%)	1 (1%)	42 (52%)	22 (27%)	13 (16%)	4 (5%)
S067	VDRL-quan.	71 (88%)	10 (12%)			56 (62%)	27 (30%)	6 (6%)	2 (2%)	27 (34%)	18 (23%)	24 (30%)	11 (14%)
S068	FTA-ABS	54 (66%)	17 (21%)	9 (11%)	2 (2%)	15 (17%)	42 (46%)	20 (22%)	14 (15%)	5 (6%)	15 (19%)	26 (33%)	34 (43%)
S069	send spec.	81 (98%)	2 (2%)			85 (92%)	7 (8%)			65 (80%)	9 (11%)	5 (6%)	2 (3%)
S070	calibrate rotator	74 (89%)	8 (10%)	1 (1%)		60 (65%)	23 (25%)	7 (8%)	2 (2%)	28 (35%)	25 (31%)	16 (20%)	12 (14%)
S071	calibrate pipette	71 (86%)	12 (14%)			49 (53%)	31 (34%)	10 (11%)	2 (2%)	20 (25%)	23 (28%)	26 (32%)	12 (15%)
S072	ser. dilut.	72 (87%)	10 (12%)	1 (1%)		57 (63%)	29 (32%)	5 (5%)		22 (28%)	24 (30%)	26 (32%)	8 (10%)
S073	CRP slide	73 (88%)	10 (12%)			72 (78%)	20 (22%)			44 (54%)	25 (31%)	8 (10%)	4 (5%)
S074	RA slide	77 (94%)	5 (6%)			79 (86%)	13 (14%)			44 (55%)	26 (33%)	7 (9%)	3 (3%)
S075	cold aggl.	76 (92%)	7 (8%)			71 (77%)	20 (22%)	1 (1%)		35 (43%)	27 (33%)	15 (19%)	4 (5%)
S076	ASOT	73 (88%)	10 (12%)			65 (71%)	24 (26%)	3 (3%)		28 (35%)	29 (36%)	19 (24%)	5 (5%)
S077	Streptozyme	77 (93%)	6 (7%)			74 (80%)	17 (19%)	1 (1%)		38 (47%)	33 (41%)	7 (9%)	3 (3%)
S078	Monospot	78 (94%)	5 (6%)			80 (87%)	12 (13%)			48 (59%)	23 (28%)	7 (9%)	3 (4%)
S079	mono-tube	66 (80%)	16 (19%)	1 (1%)		48 (52%)	28 (30%)	15 (16%)	1 (1%)	20 (25%)	24 (30%)	23 (28%)	14 (15%)
S080	latex preg.	79 (95%)	3 (4%)	1 (1%)		83 (90%)	9 (10%)			54 (67%)	17 (21%)	8 (10%)	2 (2%)

(Continued)

Table 35 - Continued

Task		MT(n=84)				MLT(n=93)				CLA(n=83)			
Number	Keywords	4	3	2	1	4	3	2	1	4	3	2	1
S081	HAI-preg.	71 (87%)	9 (11%)	2 (2%)		61 (68%)	24 (27%)	3 (3%)	2 (2%)	38 (48%)	19 (24%)	16 (20%)	7 (8%)
S082	RIA-preg.	55 (67%)	21 (26%)	5 (6%)	1 (1%)	23 (25%)	32 (35%)	30 (33%)	6 (7%)	10 (13%)	13 (16%)	23 (29%)	34 (42%)
S083	cell susp.	69 (83%)	12 (15%)	2 (2%)		43 (47%)	39 (42%)	9 (10%)	1 (1%)	20 (25%)	23 (28%)	26 (32%)	12 (15%)
S084	LE slide	66 (80%)	16 (19%)	1 (1%)		55 (60%)	27 (29%)	8 (9%)	2 (2%)	29 (36%)	22 (27%)	17 (21%)	13 (16%)
S085	ANA	52 (64%)	18 (22%)	7 (9%)	4 (5%)	18 (20%)	36 (40%)	26 (29%)	11 (12%)	5 (6%)	10 (12%)	32 (41%)	32 (41%)
S086	ANA pattern	46 (57%)	20 (25%)	11 (14%)	4 (5%)	15 (16%)	25 (27%)	35 (38%)	16 (18%)	3 (4%)	6 (8%)	22 (28%)	47 (60%)
S087	Febriles	68 (82%)	12 (15%)	3 (3%)		61 (66%)	26 (28%)	5 (5%)		31 (38%)	21 (26%)	23 (28%)	6 (7%)
S088	Igs-nephl.	38 (48%)	18 (23%)	13 (16%)	10 (13%)	8 (9%)	29 (33%)	27 (30%)	25 (28%)	2 (3%)	12 (16%)	21 (28%)	41 (53%)
S089	HAI-rubella	62 (76%)	13 (16%)	5 (6%)	2 (2%)	35 (38%)	34 (37%)	15 (17%)	7 (8%)	9 (11%)	20 (25%)	31 (39%)	20 (25%)
S090	Hb_sAg-RIA	45 (56%)	27 (33%)	6 (7%)	3 (4%)	13 (14%)	40 (44%)	23 (26%)	14 (16%)	4 (5%)	15 (19%)	28 (35%)	32 (41%)
S091	microtitre	37 (47%)	23 (30%)	12 (15%)	6 (8%)	11 (13%)	27 (31%)	30 (34%)	19 (22%)	2 (3%)	8 (10%)	25 (34%)	39 (53%)
S092	CF-viral	38 (48%)	22 (28%)	11 (14%)	8 (10%)	12 (13%)	33 (37%)	27 (30%)	18 (20%)	3 (4%)	11 (14%)	25 (32%)	39 (50%)
S093	fungal Ab.	42 (52%)	22 (28%)	9 (11%)	7 (9%)	12 (14%)	32 (37%)	26 (30%)	16 (19%)	4 (5%)	10 (13%)	26 (34%)	37 (48%)
S094	CH_{50}	35 (44%)	27 (34%)	10 (13%)	7 (9%)	10 (11%)	24 (27%)	35 (40%)	19 (22%)	4 (5%)	7 (9%)	24 (32%)	40 (53%)
S095	C3, C4	36 (46%)	26 (33%)	11 (14%)	5 (7%)	13 (15%)	27 (31%)	28 (32%)	19 (22%)	5 (7%)	9 (12%)	21 (28%)	39 (53%)
Mean frequencies:		62	14	4	2	45	18	13	7	23	18	20	19
Mean percentage:		(76%)	(17%)	(5%)	(2%)	(54%)	(22%)	(16%)	(8%)	(29%)	(22%)	(25%)	(24%)
Mean on serology:		3.69				3.28				2.64			

(Continued)

Table 35 - Continued

Task		MT(n=84)				MLT(n=93)				CLA(n=83)			
Number	Keywords	4	3	2	1	4	3	2	1	4	3	2	1
Chemistry													
C096	G.T.T.	82	2			82	9	1	5	44	22	11	5
		(98%)	(2%)			(85%)	(9%)	(1%)	(5%)	(54%)	(27%)	(13%)	(6%)
C097	xylose T.T	64	16	3		40	33	16	3	23	15	26	17
		(77%)	(19%)	(4%)		(44%)	(36%)	(17%)	(3%)	(28%)	(19%)	(32%)	(21%)
C098	insulin T.T	56	17	7	2	35	29	21	7	17	14	24	25
		(68%)	(21%)	(9%)	(2%)	(38%)	(31%)	(23%)	(8%)	(21%)	(18%)	(30%)	(31%)
C099	arterials	50	13	10	10	28	20	24	21	12	6	20	44
		(60%)	(16%)	(12%)	(12%)	(30%)	(21%)	(26%)	(23%)	(15%)	(7%)	(24%)	(54%)
C100	HbA$_1$-glyc.	56	16	8	3	24	34	22	11	5	12	32	32
		(67%)	(19%)	(10%)	(4%)	(27%)	(37%)	(24%)	(12%)	(6%)	(15%)	(40%)	(40%)
C101	glass/cal.	63	17	4		43	33	12	5	17	19	26	20
		(75%)	(20%)	(5%)		(46%)	(36%)	(13%)	(5%)	(21%)	(23%)	(32%)	(24%)
C102	analy.bal.	75	7	1	1	62	22	8	1	33	22	17	10
		(89%)	(9%)	(1%)	(1%)	(67%)	(24%)	(8%)	(1%)	(40%)	(27%)	(21%)	(12%)
C103	IL 143/main.	75	7	1	1	59	28	6		20	26	24	12
		(89%)	(9%)	(1%)	(1%)	(63%)	(30%)	(7%)		(24%)	(32%)	(29%)	(15%)
C104	troubleshoot	75	9			49	35	7	2	11	26	31	14
		(89%)	(11%)			(53%)	(38%)	(7%)	(2%)	(13%)	(32%)	(38%)	(17%)
C105	eval. kits	68	13	3		26	33	31	4	5	8	27	42
		(81%)	(15%)	(4%)		(28%)	(35%)	(31%)	(4%)	(6%)	(10%)	(33%)	(51%)
C106	QC	73	11			41	41	11		15	11	38	18
		(87%)	(13%)			(44%)	(44%)	(12%)		(18%)	(14%)	(46%)	(22%)
C107	statistics	59	22	2	1	22	22	32	16	5	5	30	42
		(70%)	(26%)	(3%)	(1%)	(24%)	(24%)	(35%)	(17%)	(6%)	(6%)	(37%)	(51%)
C108	CAP survey	76	7	1		46	28	17	1	22	20	28	12
		(91%)	(8%)	(1%)		(50%)	(30%)	(19%)	(1%)	(27%)	(24%)	(34%)	(15%)
C109	correlate	77	6	1		50	35	7		18	20	30	14
		(92%)	(7%)	(1%)		(54%)	(38%)	(8%)		(22%)	(24%)	(37%)	(17%)
C110	research	56	21	7		23	30	26	14	4	8	26	44
		(67%)	(25%)	(8%)		(25%)	(32%)	(28%)	(15%)	(5%)	(10%)	(32%)	(53%)
C111	bilirubin	80	4			72	17	2	1	40	21	13	8
		(95%)	(5%)			(78%)	(19%)	(2%)	(1%)	(49%)	(26%)	(16%)	(9%)

Table 35 - Continued

Task		MT(n=84)				MLT(n=93)				CLA(n=83)			
Number	Keywords	4	3	2	1	4	3	2	1	4	3	2	1
C112	amylase	79 (94%)	4 (5%)	1 (1%)		74 (80%)	17 (19%)	1 (1%)		39 (49%)	24 (30%)	10 (12%)	7 (9%)
C113	solutions	72 (86%)	10 (12%)	2 (2%)		41 (45%)	37 (40%)	12 (13%)	2 (2%)	15 (18%)	21 (26%)	29 (35%)	17 (21%)
C114	calculi	40 (58%)	18 (26%)	11 (16%)		25 (27%)	26 (29%)	26 (29%)	14 (15%)	8 (10%)	14 (18%)	19 (24%)	38 (48%)
C115	std.curve	71 (86%)	10 (12%)	2 (2%)		44 (48%)	33 (36%)	14 (15%)	1 (1%)	15 (18%)	13 (16%)	33 (41%)	20 (25%)
C116	urine prot.	74 (88%)	8 (10%)	2 (2%)		65 (70%)	20 (21%)	8 (9%)		34 (41%)	20 (24%)	21 (26%)	7 (9%)
C117	creat.clear.	74 (89%)	8 (10%)	1 (1%)		51 (55%)	34 (37%)	6 (7%)	1 (1%)	12 (15%)	31 (38%)	25 (31%)	13 (16%)
C118	Fe^{++}, TIBC	76 (90%)	7 (8%)	1 (1%)	1 (1%)	50 (54%)	36 (39%)	4 (4%)	3 (3%)	21 (26%)	26 (32%)	24 (29%)	11 (13%)
C119	enzymes	73 (87%)	9 (11%)	2 (2%)		54 (65%)	22 (25%)	4 (4%)	5 (6%)	26 (32%)	18 (22%)	23 (28%)	15 (18%)
C120	cholesterol	77 (92%)	4 (5%)	2 (2%)	1 (1%)	60 (65%)	27 (29%)	6 (6%)		28 (34%)	28 (34%)	17 (21%)	9 (11%)
C121	lipase	62 (76%)	15 (18%)	3 (4%)	2 (2%)	42 (46%)	23 (25%)	21 (23%)	5 (6%)	17 (21%)	18 (23%)	21 (27%)	23 (29%)
C122	gastric	69 (83%)	8 (10%)	5 (6%)	1 (1%)	49 (53%)	23 (25%)	16 (18%)	4 (4%)	19 (23%)	19 (23%)	22 (27%)	21 (26%)
C123	ETOH	63 (77%)	15 (18%)	4 (5%)		35 (55%)	14 (22%)	9 (14%)	6 (9%)	23 (29%)	13 (16%)	24 (30%)	19 (24%)
C124	UBG,extrac.	53 (65%)	17 (21%)	9 (11%)	2 (3%)	28 (31%)	27 (30%)	25 (28%)	10 (11%)	10 (13%)	16 (20%)	17 (22%)	35 (45%)
C125	Schilling	55 (68%)	14 (18%)	6 (7%)	6 (7%)	19 (21%)	39 (42%)	20 (22%)	14 (15%)	5 (6%)	15 (19%)	23 (29%)	37 (46%)
C126	preserve	76 (90%)	8 (10%)			69 (74%)	18 (19%)	5 (5%)	1 (1%)	38 (46%)	21 (26%)	13 (16%)	10 (12%)

(Continued)

Table 35 - Continued

Task		MT(n=84)				MLT(n=93)				CLA(n=83)			
Number	Keywords	4	3	2	1	4	3	2	1	4	3	2	1
C127	CSF protein	80 (95%)	3 (4%)	1 (1%)		77 (82%)	15 (16%)	2 (2%)		45 (55%)	16 (19%)	14 (17%)	7 (9%)
C128	G6PD assay	67 (82%)	9 (11%)	5 (6%)	1 (1%)	45 (49%)	30 (33%)	12 (13%)	5 (5%)	24 (30%)	18 (22%)	16 (20%)	22 (28%)
C129	BSP	56 (68%)	13 (16%)	10 (12%)	3 (4%)	28 (30%)	31 (34%)	21 (23%)	12 (13%)	13 (16%)	14 (18%)	23 (29%)	30 (37%)
C130	Diagnex	64 (78%)	12 (15%)	4 (5%)	2 (2%)	44 (48%)	31 (34%)	11 (12%)	6 (6%)	25 (31%)	19 (23%)	22 (27%)	15 (19%)
C131	catechols.	50 (62%)	16 (20%)	11 (14%)	3 (4%)	24 (27%)	36 (40%)	17 (19%)	13 (14%)	8 (10%)	19 (24%)	21 (27%)	31 (39%)
C132	cholinest.	56 (69%)	15 (19%)	8 (10%)	2 (2%)	35 (39%)	27 (30%)	18 (20%)	10 (11%)	15 (19%)	17 (22%)	24 (30%)	23 (29%)
C133	TLC	47 (58%)	20 (25%)	8 (10%)	6 (7%)	16 (17%)	31 (34%)	28 (31%)	16 (17%)	2 (3%)	9 (15%)	26 (43%)	23 (38%)
C134	L/S	52 (63%)	16 (20%)	8 (10%)	6 (7%)	20 (22%)	31 (34%)	26 (29%)	13 (15%)	4 (5%)	11 (14%)	21 (27%)	43 (54%)
C135	RIA-basic	54 (66%)	16 (19%)	8 (10%)	4 (5%)	30 (33%)	40 (43%)	20 (22%)	2 (2%)	8 (10%)	16 (20%)	33 (40%)	25 (30%)
C136	T3,T4	65 (77%)	14 (17%)	5 (6%)		35 (38%)	41 (44%)	12 (13%)	5 (5%)	9 (11%)	18 (22%)	31 (38%)	24 (29%)
C137	RIA-IgE	47 (57%)	21 (25%)	8 (10%)	9 (8%)	20 (22%)	27 (29%)	27 (29%)	18 (20%)	3 (4%)	4 (5%)	30 (37%)	44 (54%)
C138	RIA-PGE	44 (48%)	25 (27%)	23 (25%)		9 (10%)	27 (30%)	32 (36%)	22 (24%)	2 (3%)	4 (5%)	26 (33%)	46 (59%)
C139	Electrophor.	66 (78%)	15 (18%)	3 (4%)		45 (48%)	33 (36%)	13 (14%)	2 (2%)	9 (11%)	14 (17%)	39 (48%)	19 (24%)
C140	Immunoelect.	58 (70%)	20 (24%)	5 (6%)		28 (30%)	37 (40%)	22 (24%)	6 (6%)	6 (8%)	10 (12%)	32 (40%)	32 (40%)

(Continued)

Table 35 - Continued

Task		MT(n=84)				MLT(n=93)				CLA(n=83)			
Number	Keywords	4	3	2	1	4	3	2	1	4	3	2	1
C141	isoenz.-CK	68 (81%)	11 (13%)	4 (5%)	1 (1%)	34 (37%)	41 (44%)	14 (15%)	4 (4%)	11 (13%)	16 (20%)	29 (36%)	25 (31%)
C142	isenz. -LD	63 (76%)	15 (18%)	14 (5%)	1 (1%)	30 (33%)	39 (42%)	16 (17%)	7 (8%)	8 (10%)	15 (19%)	27 (34%)	30 (37%)
C143	lipoprotein	64 (77%)	14 (17%)	4 (5%)	1 (1%)	37 (40%)	34 (37%)	14 (15%)	7 (8%)	10 (12%)	15 (18%)	28 (35%)	28 (35%)
C144	Hb electro.	66 (79%)	13 (16%)	3 (4%)	1 (1%)	39 (42%)	31 (34%)	19 (21%)	3 (3%)	12 (15%)	14 (17%)	31 (39%)	23 (29%)
C145	RID	55 (66%)	20 (24%)	7 (8%)	2 (2%)	23 (25%)	39 (42%)	22 (23%)	9 (10%)	8 (10%)	9 (11%)	32 (40%)	31 (39%)
C146	pCO_2, pO_2	64 (79%)	11 (13%)	3 (4%)	3 (4%)	43 (46%)	25 (27%)	18 (19%)	7 (8%)	14 (17%)	22 (27%)	21 (26%)	24 (30%)
C147	tonometer	55 (68%)	20 (24%)	3 (4%)	3 (4%)	21 (23%)	30 (33%)	25 (27%)	15 (17%)	7 (9%)	12 (15%)	24 (30%)	36 (46%)
C148	Na^+, K^+	80 (95%)	3 (4%)	1 (1%)		84 (90%)	8 (9%)	1 (1%)		50 (62%)	16 (20%)	11 (13%)	4 (5%)
C149	Li^+	78 (93%)	5 (6%)	1 (1%)		72 (78%)	17 (18%)	4 (4%)		38 (47%)	22 (27%)	14 (17%)	7 (9%)
C150	spectroph.	79 (95%)	4 (5%)			72 (77%)	21 (22%)	1 (1%)		35 (43%)	23 (29%)	18 (22%)	5 (6%)
C151	Ca^{++}/at.abs.	52 (63%)	16 (20%)	9 (11%)	5 (6%)	22 (24%)	29 (32%)	28 (21%)	12 (13%)	7 (9%)	15 (19%)	23 (29%)	34 (43%)
C152	sweat Cl_2	66 (81%)	11 (13%)	5 (6%)		43 (75%)	13 (23%)	1 (2%)		16 (20%)	17 (21%)	29 (36%)	19 (23%)
C153	fluorometry	58 (70%)	17 (21%)	6 (7%)	2 (2%)	24 (26%)	37 (41%)	22 (24%)	8 (9%)	11 (14%)	16 (20%)	28 (35%)	25 (31%)
C154	nephelometry	54 (67%)	18 (22%)	6 (8%)	2 (3%)	26 (29%)	32 (36%)	21 (23%)	11 (12%)	13 (16%)	11 (14%)	32 (40%)	24 (30%)
C155	laser nephl.	46 (58%)	18 (23%)	10 (13%)	5 (6%)	17 (19%)	31 (34%)	27 (30%)	15 (17%)	7 (9%)	13 (17%)	26 (33%)	32 (41%)

(Continued)

Table 35 - Continued

Task		MT(n=84)				MLT(n=93)				CLA(n=83)			
Number	Keywords	4	3	2	1	4	3	2	1	4	3	2	1
C156	Gilford analy.	72	11	1		60	28	3	1	26	29	21	6
		(86%)	(13%)	(1%)		(65%)	(31%)	(3%)	(1%)	(32%)	(35%)	(26%)	(7%)
C157	SMA/SMAC	66	12	4		49	36	6	1	24	15	32	10
		(80%)	(15%)	(5%)		(53%)	(39%)	(7%)	(1%)	(30%)	(19%)	(39%)	(12%)
C158	ACA	72	9	1		56	28	5	3	32	20	20	9
		(88%)	(11%)	(1%)		(61%)	(31%)	(5%)	(3%)	(39%)	(25%)	(25%)	(11%)
C159	Rotochem	65	14	3	1	39	36	8	9	19	23	25	14
		(78%)	(17%)	(4%)	(1%)	(42%)	(39%)	(9%)	(10%)	(24%)	(28%)	(31%)	(17%)
C160	scint. ct.	57	13	5	6	21	37	17	15	13	13	25	28
		(71%)	(16%)	(6%)	(7%)	(23%)	(41%)	(19%)	(17%)	(16%)	(16%)	(32%)	(35%)
Mean frequencies:		65	13	3	2	41	29	15	7	18	17	24	22
Mean percentage:		(78%)	(16%)	(4%)	(2%)	(45%)	(32%)	(16%)	(7%)	(22%)	(21%)	(30%)	(27%)
Mean on chemistry		3.70				3.19				2.35			
Microbiology													
M161	plating	80	2			85	6			61	12	7	1
		(96%)	(4%)			(93%)	(7%)			(75%)	(15%)	(9%)	(1%)
M162	select media	78	3			73	16	1		36	24	17	3
		(96%)	(4%)			(81%)	(18%)	(1%)		(45%)	(31%)	(21%)	(4%)
M163	throat C&S	75	6	1		73	16	2		39	18	18	6
		(92%)	(7%)	(1%)		(80%)	(18%)	(2%)		(48%)	(22%)	(22%)	(8%)
M164	Gram stain	79	3			83	8			51	20	9	3
		(96%)	(4%)			(91%)	(9%)			(61%)	(24%)	(11%)	(4%)
M165	AFB	71	10	1		71	17	3		36	15	20	10
		(87%)	(12%)	(1%)		(78%)	(19%)	(3%)		(44%)	(19%)	(25%)	(12%)
M166	sp. stains	58	14	8	1	30	42	11	8	11	15	31	24
		(72%)	(17%)	(10%)	(1%)	(33%)	(46%)	(12%)	(9%)	(14%)	(18%)	(38%)	(30%)
M167	read slides	66	14	1		43	36	8	2	12	22	29	17
		(82%)	(17%)	(1%)		(48%)	(41%)	(9%)	(2%)	(15%)	(28%)	(36%)	(21%)
M168	make stains	67	13	2		51	30	7	2	30	15	23	13
		(82%)	(16%)	(2%)		(56%)	(33%)	(8%)	(3%)	(37%)	(19%)	(28%)	(16%)

(Continued)

Table 35 - Continued

Task		MT(n=84)				MLT(n=93)				CLA(n=83)			
Number	Keywords	4	3	2	1	4	3	2	1	4	3	2	1
M169	India Ink	66 (82%)	12 (15%)	2 (2%)	1 (1%)	46 (51%)	33 (36%)	9 (10%)	3 (3%)	18 (22%)	20 (25%)	26 (33%)	16 (20%)
M170	make media	68 (84%)	10 (12%)	3 (4%)		61 (68%)	21 (24%)	6 (7%)	1 (1%)	40 (49%)	15 (19%)	18 (22%)	8 (10%)
M171	reagents	60 (74%)	12 (15%)	8 (10%)	1 (1%)	27 (30%)	37 (41%)	19 (19%)	7 (7%)	11 (14%)	14 (17%)	32 (40%)	23 (29%)
M172	collect bld.c.	79 (96%)	3 (4%)			84 (92%)	6 (7%)		1 (1%)	59 (74%)	13 (16%)	4 (5%)	4 (5%)
M173	O & P prep.	70 (86%)	9 (11%)	2 (2%)	1 (1%)	60 (66%)	20 (22%)	9 (10%)	2 (2%)	30 (37%)	23 (29%)	14 (17%)	14 (17%)
M174	O&P slides	60 (73%)	16 (20%)	4 (5%)	2 (2%)	35 (38%)	35 (38%)	18 (20%)	3 (4%)	12 (15%)	19 (23%)	28 (35%)	22 (27%)
M175	viral spec.	58 (71%)	17 (21%)	7 (8%)		38 (42%)	29 (32%)	20 (22%)	4 (4%)	15 (19%)	23 (28%)	18 (22%)	25 (31%)
M176	mycology	55 (68%)	16 (20%)	7 (8%)	3 (4%)	37 (41%)	30 (33%)	17 (19%)	6 (7%)	20 (25%)	17 (21%)	16 (21%)	27 (34%)
M177	vaccines	23 (29%)	24 (30%)	14 (18%)	18 (23%)	7 (8%)	19 (22%)	24 (28%)	37 (42%)	2 (3%)	6 (8%)	29 (37%)	40 (52%)
M178	process AFB	58 (72%)	15 (18%)	5 (6%)	3 (4%)	49 (55%)	22 (24%)	13 (14%)	6 (7%)	24 (30%)	18 (23%)	21 (26%)	17 (21%)
M179	I.D. AFB	54 (67%)	18 (22%)	8 (10%)	1 (1%)	26 (29%)	32 (35%)	25 (28%)	7 (8%)	7 (8%)	22 (27%)	23 (28%)	31 (37%)
M180	read plates	68 (83%)	14 (17%)			44 (48%)	36 (40%)	11 (12%)		13 (16%)	17 (21%)	33 (41%)	18 (22%)
M181	I.D. GNR	69 (84%)	13 (16%)			45 (50%)	32 (35%)	13 (14%)	1 (1%)	14 (17%)	21 (26%)	30 (36%)	17 (21%)
M182	select bchm.	65 (80%)	16 (19%)	1 (1%)		37 (41%)	38 (42%)	16 (17%)		9 (11%)	20 (25%)	33 (41%)	19 (23%)
M183	read biochem.	62 (77%)	19 (23%)			45 (50%)	33 (37%)	12 (13%)		15 (18%)	20 (25%)	31 (38%)	15 (18%)

(Continued)

Table 35 - Continued

Task		MT(n=84)				MLT(n=93)				CLA(n=83)			
Number	Keywords	4	3	2	1	4	3	2	1	4	3	2	1
M184	CDC surveys	65 (79%)	12 (15%)	5 (6%)		35 (38%)	30 (33%)	23 (25%)	3 (4%)	10 (12%)	19 (24%)	27 (33%)	25 (31%)
M185	set up sens.	74 (90%)	7 (9%)	1 (1%)		63 (69%)	21 (23%)	7 (8%)		29 (36%)	24 (29%)	16 (20%)	12 (15%)
M186	read sens.	73 (88%)	10 (12%)			66 (72%)	24 (26%)	2 (2%)		31 (38%)	26 (32%)	18 (22%)	6 (8%)
M187	MBC	56 (69%)	17 (21%)	3 (4%)	5 (6%)	29 (32%)	37 (40%)	17 (19%)	8 (9%)	6 (8%)	16 (20%)	30 (37%)	28 (35%)
M188	MIC	61 (75%)	12 (15%)	4 (5%)	4 (5%)	30 (33%)	37 (41%)	16 (18%)	7 (8%)	8 (10%)	14 (18%)	28 (35%)	29 (37%)
M189	antibiotics	48 (60%)	14 (17%)	14 (17%)	5 (6%)	13 (14%)	40 (45%)	21 (23%)	16 (18%)	4 (5%)	11 (14%)	27 (35%)	36 (46%)
M190	Schlichter	43 (54%)	22 (27%)	12 (15%)	3 (4%)	13 (14%)	32 (36%)	25 (28%)	20 (22%)	2 (3%)	10 (13%)	23 (29%)	44 (55%)
M191	biotyping	60 (75%)	15 (19%)	4 (5%)	1 (1%)	36 (40%)	31 (34%)	18 (20%)	5 (6%)	10 (13%)	19 (24%)	26 (33%)	24 (30%)
M192	interpret	69 (83%)	11 (13%)	3 (4%)		41 (45%)	36 (40%)	12 (13%)	2 (2%)	13 (16%)	16 (20%)	33 (41%)	18 (23%)
M193	QC	72 (87%)	10 (12%)	1 (1%)		51 (57%)	31 (34%)	8 (9%)		19 (23%)	23 (28%)	32 (40%)	7 (9%)
M194	records	75 (90%)	8 (10%)			69 (75%)	18 (20%)	4 (4%)	1 (1%)	40 (51%)	23 (30%)	12 (15%)	3 (4%)
M195	teach	74 (89%)	8 (10%)	1 (1%)		25 (27%)	48 (52%)	14 (15%)	5 (6%)	4 (5%)	6 (8%)	37 (47%)	31 (40%)
M196	evaluate	70 (85%)	10 (12%)	2 (3%)		24 (27%)	36 (40%)	23 (25%)	7 (8%)	5 (6%)	6 (8%)	27 (35%)	40 (51%)
M197	supervise	68 (82%)	11 (13%)	3 (4%)	1 (1%)	24 (26%)	24 (26%)	30 (33%)	14 (15%)	4 (5%)	4 (5%)	18 (22%)	55 (68%)
M198	correlate	53 (66%)	18 (22%)	9 (11%)	1 (1%)	32 (36%)	17 (19%)	29 (32%)	12 (13%)	4 (5%)	6 (7%)	25 (32%)	44 (56%)

(Continued)

Table 35 - Continued

Task		MT(n=84)				MLT(n=93)				CLA(n=83)			
Number	Keywords	4	3	2	1	4	3	2	1	4	3	2	1
M199	infec. c'ttee	62 (76%)	15 (18%)	5 (6%)		28 (31%)	16 (17%)	26 (29%)	21 (23%)	7 (9%)	5 (6%)	17 (21%)	51 (64%)
M200	spills	68 (82%)	11 (13%)	3 (4%)	1 (1%)	43 (47%)	29 (31%)	13 (14%)	3 (4%)	25 (31%)	11 (14%)	26 (32%)	19 (23%)
M201	sputum	68 (82%)	13 (16%)	2 (2%)		50 (55%)	25 (27%)	13 (14%)	3 (4%)	27 (34%)	18 (22%)	18 (22%)	17 (21%)
M202	KOH prep.	61 (74%)	15 (18%)	5 (6%)	1 (2%)	33 (36%)	36 (40%)	16 (18%)	6 (6%)	11 (14%)	16 (20%)	27 (34%)	26 (32%)
M203	fungi	58 (72%)	13 (16%)	8 (10%)	2 (2%)	20 (22%)	41 (46%)	21 (23%)	8 (9%)	6 (8%)	6 (8%)	33 (42%)	33 (42%)
M204	house cult.	64 (79%)	10 (12%)	6 (8%)	1 (1%)	35 (39%)	34 (38%)	14 (16%)	6 (7%)	13 (17%)	19 (24%)	24 (31%)	22 (28%)
M205	fluor. ab.	57 (71%)	12 (15%)	9 (11%)	2 (3%)	22 (25%)	38 (42%)	22 (25%)	7 (8%)	7 (9%)	12 (15%)	28 (35%)	32 (41%)
M206	fluor.'scope	57 (71%)	15 (19%)	7 (9%)	1 (1%)	29 (32%)	28 (31%)	25 (28%)	8 (9%)	13 (17%)	12 (15%)	27 (34%)	27 (34%)
M207	autoclave	75 (90%)	6 (7%)	2 (3%)		77 (84%)	10 (11%)	2 (2%)	3 (3%)	50 (62%)	20 (25%)	6 (7%)	5 (6%)
M208	Gas Pak jar	75 (92%)	6 (7%)	1 (1%)		77 (84%)	14 (15%)	1 (1%)		48 (59%)	20 (25%)	9 (11%)	4 (5%)
M209	gas chromat.	51 (64%)	18 (22%)	8 (10%)	3 (4%)	14 (15%)	33 (36%)	29 (32%)	14 (16%)	2 (2%)	6 (7%)	39 (48%)	36 (43%)
M210	Autobac	65 (80%)	10 (12%)	3 (4%)	3 (4%)	48 (53%)	26 (29%)	13 (14%)	3 (4%)	21 (27%)	19 (24%)	24 (30%)	15 (19%)
M211	purchasing	69 (83%)	12 (14%)	2 (3%)		33 (36%)	39 (43%)	14 (15%)	5 (6%)	11 (14%)	16 (20%)	31 (39%)	22 (27%)

(Continued)

Table 35 - Continued

Task		MT(n=84)				MLT(n=93)				CLA(n=83)			
Number	Keywords	4	3	2	1	4	3	2	1	4	3	2	1
M212	asepsis	69 (83%)	11 (13%)	3 (4%)		57 (63%)	20 (22%)	14 (15%)		28 (35%)	21 (26%)	18 (23%)	13 (16%)
M213	protocol	65 (78%)	14 (17%)	4 (5%)		22 (24%)	33 (36%)	24 (27%)	12 (13%)	2 (3%)	16 (20%)	22 (27%)	40 (50%)
M214	urine c&s	78 (94%)	4 (5%)	1 (1%)		5 (83%)	13 (14%)	2 (2%)	1 (1%)	48 (60%)	19 (24%)	8 (10%)	5 (6%)
Mean frequencies:		64	12	4	1	44	28	14	6	20	16	23	22
Mean percentage:		(79%)	(15%)	(5%)	(1%)	(48%)	(30%)	(15%)	(7%)	(25%)	(20%)	(28%)	(27%)
Mean on microbiology		3.75				3.23				2.46			
Hematology													
H215	venipunct.	78 (95%)	4 (5%)			88 (96%)	3 (3%)	1 (1%)		64 (80%)	12 (15%)	1 (1%)	3 (4%)
H216	fingerstk.	79 (96%)	3 (4%)			88 (96%)	2 (2%)	2 (2%)		64 (80%)	12 (15%)	1 (1%)	3 (4%)
H217	bld.smear	81 (99%)	1 (1%)			90 (90%)	2 (2%)			70 (84%)	9 (11%)	2 (2%)	2 (2%)
H218	manual WBC	78 (94%)	3 (4%)	2 (2%)		79 (85%)	14 (15%)			68 (85%)	7 (9%)	3 (4%)	2 (2%)
H219	eosin ct.	76 (92%)	6 (7%)	1 (1%)		62 (68%)	26 (28%)	4 (4%)		42 (53%)	20 (25%)	15 (18%)	3 (4%)
H220	auto. WBC	80 (98%)	1 (1%)	1 (1%)		84 (91%)	6 (7%)	1 (1%)	1 (1%)	22 (28%)	22 (35%)	25 (31%)	5 (6%)
H221	Coulter S^+	79 (96%)	3 (4%)			81 (88%)	11 (12%)			54 (68%)	20 (25%)	4 (5%)	2 (2%)
H222	QC of S^+	77 (93%)	5 (6%)	1 (1%)		58 (63%)	28 (30%)	6 (7%)		45 (56%)	29 (36%)	4 (5%)	2 (3%)
H223	main.& QC	76 (92%)	7 (8%)			51 (55%)	36 (39%)	5 (6%)		22 (27%)	31 (38%)	22 (28%)	6 (7%)

(Continued)

Table 35 - Continued

Task		MT(n=84)				MLT(n=93)				CLA(n=83)			
Number	Keywords	4	3	2	1	4	3	2	1	4	3	2	1
H224	ESR	78 (95%)	3 (4%)	1 (1%)		88 (96%)	4 (4%)			17 (21%)	25 (31%)	29 (36%)	10 (12%)
H225	OF test	68 (83%)	10 (12%)	3 (3%)	1 (1%)	49 (54%)	34 (38%)	4 (4%)	3 (3%)	62 (78%)	14 (18%)	2 (2%)	2 (2%)
H226	Ham test	57 (72%)	18 (23%)	4 (5%)		29 (33%)	38 (43%)	15 (17%)	6 (7%)	19 (24%)	20 (25%)	23 (29%)	18 (22%)
H227	cyanmetHb.	69 (86%)	10 (13%)	1 (1%)		46 (51%)	30 (33%)	11 (12%)	3 (3%)	18 (23%)	15 (19%)	26 (33%)	20 (25%)
H228	spun Hct.	81 (99%)	1 (1%)			88 (96%)	4 (4%)			65 (81%)	9 (11%)	4 (5%)	2 (3%)
H229	calib. Hct.	68 (82%)	13 (16%)	2 (2%)		43 (47%)	36 (39%)	11 (12%)	2 (2%)	19 (23%)	16 (20%)	32 (40%)	14 (17%)
H230	make Wrights	69 (86%)	9 (11%)	2 (3%)		51 (57%)	26 (29%)	12 (13%)	1 (1%)	23 (29%)	24 (31%)	22 (22%)	9 (9%)
H231	stain smear	79 (96%)	2 (3%)	1 (1%)		88 (96%)	4 (4%)			64 (81%)	11 (14%)	2 (3%)	2 (3%)
H232	retic stain	72 (89%)	7 (9%)	2 (2%)		67 (74%)	19 (21%)	4 (4%)	1 (1%)	37 (47%)	18 (23%)	17 (22%)	6 (8%)
H233	Heinz smear	72 (90%)	7 (9%)	1 (1%)		53 (58%)	28 (30%)	9 (10%)	2 (2%)	22 (28%)	25 (32%)	23 (29%)	9 (11%)
H234	retic ct.	77 (92%)	6 (7%)	1 (1%)		77 (84%)	14 (15%)	1 (1%)		41 (52%)	23 (29%)	12 (15%)	3 (4%)
H235	assist/b.mar.	67 (82%)	9 (11%)	3 (4%)	3 (4%)	48 (52%)	27 (29%)	10 (11%)	7 (8%)	20 (25%)	25 (31%)	16 (20%)	19 (24%)
H236	marrow slide	69 (83%)	10 (12%)	1 (1%)	3 (4%)	49 (53%)	31 (34%)	8 (9%)	4 (4%)	26 (32%)	17 (21%)	22 (27%)	15 (19%)
H237	cytochem.	56 (67%)	18 (22%)	3 (4%)	6 (7%)	30 (33%)	36 (40%)	16 (18%)	9 (9%)	8 (10%)	17 (22%)	28 (35%)	26 (33%)

(Continued)

Table 35 - Continued

Task		MT(n=84)				MLT(n=93)				CLA(n=83)			
Number	Keywords	4	3	2	1	4	3	2	1	4	3	2	1
H238	read LAPs	51 (62%)	20 (25%)	6 (7%)	5 (6%)	14 (15%)	35 (39%)	28 (31%)	14 (15%)	2 (3%)	12 (15%)	28 (35%)	37 (47%)
H239	norm. diff	77 (95%)	4 (5%)			68 (76%)	17 (19%)	4 (4%)	1 (1%)	36 (46%)	31 (39%)	7 (9%)	5 (6%)
H240	WBC estim.	72 (89%)	8 (10%)	1 (1%)		42 (46%)	33 (36%)	15 (16%)	1 (1%)	27 (34%)	26 (33%)	18 (23%)	8 (10%)
H241	Abn. WBC	53 (68%)	22 (28%)	2 (3%)	1 (1%)	25 (31%)	32 (40%)	19 (24%)	4 (5%)	9 (11%)	16 (20%)	29 (37%)	25 (32%)
H242	Abn. RBC	67 (85%)	12 (15%)			47 (58%)	28 (35%)	5 (6%)	1 (1%)	24 (30%)	18 (23%)	26 (33%)	11 (14%)
H243	troublesht.	60 (77%)	10 (13%)	6 (8%)	2 (3%)	23 (29%)	35 (44%)	16 (20%)	5 (6%)	10 (13%)	13 (17%)	39 (50%)	16 (21%)
H244	Abn. plts.	65 (82%)	13 (16%)		1 (1%)	40 (49%)	31 (38%)	8 (10%)	2 (2%)	22 (28%)	17 (22%)	23 (29%)	17 (22%)
H245	corr. plts.	69 (87%)	10 (13%)			52 (64%)	24 (30%)	5 (6%)		25 (32%)	28 (35%)	18 (23%)	8 (10%)
H246	plt. cts.	71 (90%)	8 (10%)			52 (64%)	27 (33%)	2 (2%)		31 (40%)	20 (26%)	21 (27%)	6 (8%)
H247	auto. plts.	72 (91%)	6 (8%)	1 (1%)		63 (78%)	15 (19%)	3 (4%)		38 (48%)	21 (27%)	17 (22%)	3 (4%)
H248	corr. resul.	71 (90%)	4 (5%)	4 (5%)		39 (48%)	35 (43%)	7 (9%)		14 (18%)	21 (27%)	33 (42%)	11 (14%)
H249	Abn. Hb.	63 (81%)	11 (14%)	2 (3%)	2 (3%)	41 (51%)	28 (35%)	9 (11%)	2 (2%)	18 (23%)	22 (28%)	25 (32%)	13 (17%)
H250	Hb. elect.	60 (76%)	13 (16%)	6 (8%)		21 (26%)	41 (51%)	16 (20%)	2 (2%)	7 (9%)	15 (19%)	34 (43%)	23 (29%)
H251	LE test	64 (80%)	12 (15%)	3 (4%)	1 (1%)	42 (52%)	29 (32%)	10 (12%)		16 (20%)	19 (24%)	32 (41%)	12 (15%)

(Continued)

Table 35 - Continued

Task Number	Keywords	MT(n=84) 4	3	2	1	MLT(n=93) 4	3	2	1	CLA(n=83) 4	3	2	1
H252	HbA_2/column	41 (54%)	28 (33%)	6 (8%)	4 (5%)	16 (27%)	29 (37%)	24 (31%)	9 (12%)	5 (6%)	13 (17%)	31 (40%)	28 (36%)
H253	2-3,DPG	42 (57%)	17 (23%)	9 (12%)	6 (8%)	12 (16%)	28 (37%)	26 (34%)	10 (13%)	5 (7%)	13 (17%)	27 (36%)	30 (40%)
H254	hemostasis	55 (69%)	19 (24%)	5 (6%)	1 (1%)	18 (22%)	40 (49%)	21 (26%)	2 (2%)	7 (9%)	11 (14%)	33 (41%)	29 (36%)
H255	bleed/time	71 (90%)	7 (9%)	1 (1%)		59 (73%)	15 (19%)	7 (9%)		37 (47%)	22 (28%)	12 (15%)	8 (10%)
H256	thrombin t.	68 (86%)	10 (13%)	1 (1%)		54 (67%)	20 (25%)	7 (9%)		30 (38%)	19 (24%)	22 (28%)	8 (10%)
H257	WBCT	75 (95%)	3 (4%)	1 (1%)		67 (83%)	12 (15%)	2 (2%)		44 (56%)	20 (25%)	12 (15%)	3 (4%)
H258	PT/PTT	74 (94%)	5 (6%)			70 (86%)	9 (11%)	2 (2%)		35 (44%)	33 (42%)	7 (9%)	4 (5%)
H259	fibrinogen	67 (80%)	11 (14%)		2 (2%)	45 (56%)	29 (36%)	7 (9%)		24 (30%)	24 (30%)	22 (27%)	10 (13%)
H260	factor/sub.	43 (55%)	26 (33%)	8 (10%)	1 (1%)	12 (15%)	28 (35%)	32 (41%)	7 (9%)	4 (5%)	8 (10%)	22 (28%)	44 (56%)
H261	factors	47 (60%)	22 (28%)	7 (9%)	2 (3%)	16 (20%)	30 (38%)	24 (30%)	9 (11%)	7 (9%)	9 (12%)	24 (31%)	38 (49%)
H262	FSP test	59 (76%)	13 (17%)	3 (4%)	3 (4%)	34 (43%)	26 (33%)	15 (19%)	4 (5%)	21 (27%)	12 (15%)	23 (29%)	22 (28%)
H263	prot.SO_4	50 (65%)	17 (22%)	3 (4%)	7 (9%)	16 (21%)	31 (40%)	20 (26%)	11 (14%)	9 (12%)	11 (14%)	23 (30%)	33 (43%)
H264	plt. agg.	46 (61%)	15 (20%)	9 (12%)	6 (8%)	13 (17%)	28 (37%)	22 (29%)	13 (17%)	5 (7%)	9 (12%)	25 (33%)	36 (48%)

(Continued)

Table 35 - Continued

Task		MT(n=84)				MLT(n=93)				CLA(n=83)			
Number	Keywords	4	3	2	1	4	3	2	1	4	3	2	1
H265	clot retr.	67 (85%)	9 (11%)	2 (3%)	1 (1%)	53 (66%)	18 (22%)	7 (9%)	2 (2%)	34 (43%)	14 (18%)	18 (23%)	13 (16%)
H266	euglobulin	55 (71%)	12 (15%)	6 (8%)	5 (6%)	22 (28%)	31 (39%)	16 (20%)	10 (13%)	16 (21%)	7 (9%)	23 (29%)	32 (41%)
H267	heparin	66 (84%)	8 (10%)	4 (5%)	1 (1%)	47 (59%)	26 (32%)	5 (6%)	2 (2%)	25 (32%)	21 (27%)	23 (29%)	10 (13%)
H268	autm/coag.	67 (86%)	7 (9%)	1 (1%)	3 (4%)	51 (64%)	22 (27%)	3 (4%)	4 (5%)	31 (40%)	17 (22%)	16 (21%)	14 (18%)
H269	urea/XIII	50 (66%)	10 (13%)	15 (20%)	1 (1%)	19 (25%)	33 (43%)	18 (23%)	7 (9%)	10 (13%)	12 (16%)	28 (37%)	25 (33%)
H270	b.mar.slide	28 (36%)	24 (31%)	21 (27%)	5 (6%)	6 (8%)	12 (16%)	28 (36%)	31 (40%)	3 (4%)	3 (4%)	11 (14%)	60 (78%)
Mean frequencies:		66	10	3	1	48	24	10	2	27	17	19	15
Mean percentage:		(88%)	(12%)	(4%)	(1%)	(57%)	(29%)	(12%)	(2%)	(35%)	(22%)	(24%)	(19%)
Mean on hematology:		3.81				3.34				2.74			
Grand frequencies:		66	12	3	1	45	26	13	5	22	17	21	20
Grand percentage:		(80%)	(15%)	(4%)	(1%)	(51%)	(29%)	(15%)	(5%)	(28%)	(21%)	(26%)	(25%)
Grand mean:		3.76				3.29				2.59			

BIOGRAPHICAL SKETCH

Judith Anne Davis (Anderson) was the first of a set of twins born to Herbert A. and Estelle H. Davis, under the sign of Gemini, on May 25, 1947, in Henderson, North Carolina. Her formative years were spent in Fayetteville, North Carolina, where she attended the Fayetteville city schools and excelled in English, science, languages, sports, and drama.

High Point College, High Point, North Carolina, awarded her the degree of Bachelor of Science with majors in English and biology on May 25, 1969. While at High Point, her activities included the yearbook staff, the Methodist Student Fellowship, the college choir, and intramural sports. She was employed by the college infirmary during her undergraduate days, and her interest in medical sciences was nurtured there. Her interest in English took her to the British Isles to study literature of Keats, Burns, Joyce, and others.

Following graduation from High Point, her bent for medical sciences took her to the Medical College of Georgia to study medical physiology in lieu of English literature. She completed medical technology education at the Bowman Gray School of Medicine in 1971, and upon graduating, she accepted a postion of assistant chief technologist in a small hospital in North Carolina.

In 1973, Judi was invited to assist in the establishment of the first MLT program in North Carolina at Sandhills Community College, near Pinehurst. After the program was fully accredited and graduates were succeeding in their work, she accepted a sabbatical to pursue graduate work at the University of Florida, which awarded her a full fellowship from the W.K. Kellog Fund for allied health teacher preparation. She received her MEd in March, 1977, and was subsequently enrolled in the doctoral program in curriculum and instruction (health occupations specialty). Following the qualifying examinations in January, 1978, she accepted the position of Chairman of the Allied Health Department at Sandhills Community College, a position she currently holds.

Her professional memberships include the American Society of Clinical Pathologists (associate), the American Society of Allied Health Professionals, the American Society for Medical Technology and the North Carolina Society for Medical Technology. She is also a member of Phi Kappa Phi. She serves as a consultant to the North Carolina Department of Community Colleges in medical technology. She is a site visitor for accreditation of MLT programs, and she writes critiques of self-evaluation reports for programs undergoing the accreditation process. She is Chairman of the Education Scientific Assembly for the North Carolina Society for Medical Technology.

Her hobbies and interests are consonant with those of other "Gemini's" and "ENTPs"--she enjoys everything including tennis, snow skiing, vocal singing, cello, and photographing erythrocytes. She is a soprano soloist with the Moore County Choral Society and a member of the Sandhills Community College orchestra.

In 1978 she married James William Anderson of Gainesville and Mobile. They make their home near Pinehurst, North Carolina, where they teach at Sandhills Community College.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Margaret K. Morgan

Margaret K. Morgan, Chairman
Associate Professor of
Instructional Leadership and
Support

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

James W. Hensel

James W. Hensel
Professor of Instructional
Leadership and Support

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Ronald K. Bass

Ronald K. Bass
Associate Professor of Dentistry

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Fred E. West
Visiting Assistant Professor
of Health and Hospital
Administration

This dissertation was submitted to the Graduate Faculty of the Department of Curriculum and Instruction in the College of Education and to the Graduate Council, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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F.G. Stehli
Dean, Graduate School